SCIENCE

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AIMS, METHODS, AND RESULTS IN MEDICAL EDUCATION[1]

MEDICAL education represents an organized attempt to train men to apply scientific methods to the prevention, cure or alleviation of disease and to the advance of medical knowledge. To this end the public, the teachers and the students all contribute. The public through endowment or state support now pays the more liberally supported schools at least $300 per year per student, or $1,200 for the four-year course; the teachers by rendering skilled service for less than what they might earn in practise probably contribute at least as much, while the time of the student in addition to his tuition fees and other expenses makes his contribution worth not less than $1,000 per year or $4,000 for the course, in addition to which he usually devotes several thousand dollars' worth of time to postgraduate study.

The public gets the largest returns from the investment both from the advances in medical knowledge which come from the better supported schools and from the increased efficiency of medical service which benefits not only those individuals who pay for services received but also the community at large. The students, who furnish by far the largest part of the investment, may ultimately get some fair financial return from this investment but must look to joy of service for the chief return. The teachers find their main reward in the companionship with youth in devotion to ideals.

[1] Presidential address at the annual meeting of the Association of American Medical Colleges, Chicago, February 8, 1916.

The results of the joint product of educational plants, teachers and students, are to be determined, on the one hand by the scientific output of the institution and on the other hand by the ability of the graduates to perform the services for which they are trained. This ability does not become fully manifest until the youths of to-day become the mature men of to-morrow. We do not manufacture a product ready to work perfectly the minute it is turned out and for which there is an eager market to stimulate us to devise methods of turning out an ever greater quantity at less cost. On the contrary we have to devise methods which will train men to fill in a worthy way the medical needs of the nation a generation in the future, men for whom when first turned out the public does not seem particularly eager.

Our methods should be designed to furnish the requisite training as directly, simply and inexpensively as possible, compatible with adequate results. In studying and trying out methods we should, however, focus our attention on the end results desired, not on artificial standards such as have at times been introduced by efficiency engineers and other professional students of other peoples' business who have been active of late in the field of education and who are apt, because of the difficulty of determining the nature of the products of an educational institution, to adopt some such standard as the unit hour of instruction as the product or to base estimates of efficiency on the elaboration of machinery. On the whole, however, I believe that we have been fortunate in the breadth of view shown by outside investigators of our own field of education and that we ourselves are to be blamed for too much emphasis on time requirements, too great a readiness to standardize without sufficient study of the ultimate result produced. This attitude has led to a condition where the requirement of two years of premedical college work has made much more rapid progress in the requirements of licensure to practise in various states than have practical examinations in medicine.

Under the cheaper methods of medical instruction which prevailed in this country until recent years the results on the whole were not satisfactory. It has been stated that as many as forty per cent. of medical graduates quit the practise of medicine within a few years after leaving the medical school. Of the rest some by natural ability and hard study subsequent to graduation became of great value to society and others, allowing themselves to drift, became venders of prescriptions but not men able to apply modern science to relieve disease.

The recent developments in medical education have added greatly to the expense of maintaining medical schools and to the cost in time and money to those seeking a medical education. Are the results satisfactory? Can they be improved? Can the expense be reduced without injuring the product? These questions can not be answered satisfactorily at the present time, first, because of the relatively short period that the newer methods of medical education have been in force and, second, because of the absence of satisfactory records of the subsequent careers of our graduates. They are, however, questions which every institution should carefully study and from time to time various institutions should report the results of such studies because of the help to other institutions thus furnished. Only one institution, at present, the Johns Hopkins Medical School, I believe, furnishes an account of the subsequent careers of each of its graduates. Since this institution was the first

to assume what have since become, with a few modifications, the modern standards of medical education in this country[2] a statistical study of the careers of the graduates of the first ten years, 1897–1906 inclusive, may be of value in throwing light on the results produced by recent trends in medical education. To me the study has been of special interest because I was a member of the first class and assisted in teaching the other classes.

TABLE I

Careers of Graduates

(J. H. U., 1897–1906)

	Total Number	Women	First 5 Classes	Second 5 Classes
	456	55	166	290
Died	5.7%	7.3%	8.4%	4.1%
Withdrawn	3.3	18.2	6	1.8
Practise	80	70.9	71.1	85.2
Science	8.8	1.8	13.3	6.2
Administration	2.2	1.8	1.2	2.8

[2] The requirement of premedical college work covering physics, chemistry, biology and a modern language, adopted to the extent of one year by the Association of American Medical Colleges and to the extent of two or more years by a large proportion of the schools in the association is a modification of the requirements adopted by the Johns Hopkins Medical School beginning with the first class which entered in 1893. For matriculation a student was required to have a college degree and to have had college training in physics, chemistry and biology, a reading knowledge of French and German and as much Latin as may be studied in two years in a high school. With the exception of the last, the only high-school subject specifically required, and some of the modern language which could be studied in the high school, the specific requirements of the Johns Hopkins could be covered by two years of college work. The standards now adopted by most of the better schools are quite similar except that but one modern language is required instead of two. Furthermore, the Johns Hopkins curriculum devoted the first two years to work in the basal medical sciences, the last two to clinical work, an arrangement in the main now generally adopted. The standard of full-time teachers and investigators in the basal sciences then established has likewise been widely accepted.

TABLE II

Fields of Practise

(J. H. U. Graduates, 1897–1906)

	Total in Practise	Women in Practise	First 5 Classes	Second 5 Classes
	365	39	118	247
General practise without specialization	22.2%	35.8%	16.9%	24.7%
General practise with specialization	20.5	46.1	18.7	21.5
Internists	9.6		18.7	5.3
Medical specialties	11.2	7.7	5.1	14.2
General surgery	15.9		17.8	15
Surgical specialties	9.9		10.2	9.7
Eye, ear, nose and throat	5.2		6.8	4.1
Obstetrics	5.5	10.2	5.9	5.3

TABLE III

Subdivisions of Activities

(J. H. U. Graduates, 1897–1906)

General Practise

Number of Individuals, 156

	Per Cent.
No specialty indicated	51.9
General practise combined with	
Public health work	9
Laboratory work	7.8
Pediatrics	5.8
Obstetrics	1.9
Surgery	10.9
U. S. army surgeons	3.8
Institutional work	3.8
Medical missionaries	5.1

Teachers, 7.7 per cent.

Medicine

Number of Individuals, 76

	Per Cent.
Internists	46
Pediatrists	14.5
Neurologists	10.5
Dermatologists	8
Laboratory diagnosis	21.0

Teachers, 63.2 per cent.

Surgery

Number of Individuals, 133

	Per Cent.
General surgery	43.6
Gynecology	10.5
Orthopedics	7.5
Genito-urinary surgery	9
Eye, ear, nose and throat	14.3
Obstetrics	15

Teachers, 42.1 per cent.

Science

Number of Individuals, 40

	Per Cent.
Anatomy	15
Bacteriology	2.5
Physiology	15
Hygiene	5
Roentgenology	2.5
Pharmacology	7.5
Medicine	12.5
Pathology	40

Teachers, 90 per cent.

Administration

Number of Individuals, 10

	Per Cent.
Hospital	50
Public health	40
Medical association	10

Teachers, 0

Four hundred and fifty-six students were graduated in the ten classes under consideration, 166 in the first five classes, 290 in the second five classes. Fifty-five were women.

Table I. shows the general careers of these graduates. Twenty-six, 5.7 per cent., have died, fifteen, 3.3 per cent., have retired from practise. Of the latter, nine are women who retired because of marriage. Only five men, 1.3 per cent. of the total number, have withdrawn from medical work. These figures are certainly in marked contrast to the forty per cent. of graduates supposed to have dropped out of practise under the old system of medical education.

Of the graduates now engaged in medicine 80 per cent. are in practise, 8.8 per cent. are engaged in teaching or scientific work and 2.2 per cent. in medical administrative work.

Tables II. and III. illustrate the specialization within the fields of practise and scientific work that has taken place. The percentage of graduates within each of these fields is shown. The data tabulated are based on the records published in the Johns Hopkins Circular and in the American Medical Directory. It is probable that the specialization is carried even further than here shown.

Specialization carries with it in most cases, and should in all cases, special training beyond that offered in the medical school. Table IV. shows the number of graduates in each of the main subgroups and the percentage of graduates in each of these groups whose records show special training subsequent to graduation. These records, as published in the Johns Hopkins Circular, are necessarily incomplete and undoubtedly represent far less than the total amount of postgraduate work and study. In the third column the percentage is shown of the graduates of each group who took a hospital interneship of one or more years, in the fourth column the percentage of those taking an interneship of two or more years, in the fifth column the percentage of those who took laboratory work but not a clinical interneship, in the sixth column the percentage of those whose postgraduate work was confined to graduate study, in the seventh column the percentage of those whose records indicate no formal work subsequent to graduation, and in the eighth column the percentage of those who took an interneship at the Johns Hopkins Hospital. Since these last interneships are open to students in the order of their class standings, the percentage of those in a group accepting them indicates the general scholarship of the group, although some of the best students in each class take work elsewhere.

From this table it may be seen that the 81 graduates now in general practise whose records shows no specialization belonged to the group with a relatively low grade of scholarship as undergraduates and with

TABLE IV

Special Training after Graduation

(J. H. U. Graduates, 1897–1906)

1	2	3	4	5	6	7	8	
Group	Number in Group	Hospital Internship at Least One Year	Further Residence Training	Laboratory Work Only	Graduate Work Only	Special Training not Specified	J.H.H. Internes	
		% of Group	% of Group	% of Group	% of Group	% of Group	% of Group	
General practise without specialization	81	63	34.6	3.7	1.2	32.1	16	
General practise with specialization	75	80	56	6.7	1.3	12	17.4	
Total general practise	156	71.2	44.9	5.1	1.3	22.4	16.9	
Internists	35	77.1	62.9	14.5	2.9	5.8	42.9	
Pediatrists	11	72.7	63.6	18.2	9.1		18.2	
Neurologists	8	75	75	12.5		12.5	0	(37.5% Disp.)
Dermatologists	6	33.3	16.7		66.7		0	(66.7% Disp.)
Laboratory diagnosis	16	25	6.3	75			0	
Total medicine	76	61.9	48.77	25	9.2	3.9	22.4	
General surgery	58	87.9	74.1	7	1.7	3.4	46.6	
Gynecology	14	85.7	57.1	7.1		7.1	71.4	
Orthopedics	10	100	60				50	
Genito-urinary	12	75	58.3		8.3	16.6	33.3	
Eye, ear, nose, etc.	19	58	21	5.3	26.3	10.5	10.5	
Obstetrics	20	90	80			10	55	
Total surgery	133	83.5	63.2	4.5	5.3	6.8	44.4	
Science teachers	40	50	15	50			42.5	
Hospital superintendents	5	100	100				0	
Public health officers	4	75	25	25			0	
Others	1			100			0	
Total	415	71.6	48.9	13	4	11.3	29	

the least training after graduation, 32.1 per cent. giving no record of such training.

The 75 graduates in general practise who are specializing to a greater or less extent, on the other hand, show but 12 per cent. without interneship or some other form of postgraduate training.

The 76 graduates in the group of specialists in internal medicine show but 3.9 per cent. without special postgraduate training, although in this group laboratory work, chiefly in pathology, has been to a considerable extent substituted for clinical interneships. The two men of the group who now hold the chairs of medicine at Harvard and Columbia, respectively, had a postgraduate training largely in pathology. The internists show a high percentage of Johns Hopkins Hospital interneships while the neurologists and dermatologists have depended more on dispensary training, a third of the first group and two thirds of the second having had work at the Johns Hopkins Hospital Dispensary.

The 133 graduates who have specialized in general surgery and its various branches show a high record of undergraduate scholarship as evinced by the high percentage of Johns Hopkins Hospital interneship, and few, only 6.8 per cent., without records of special postgraduate work, chiefly interneships. The length of time spent by many of these surgeons as internes and residents in hospitals is considerable.

Thus the total resident hospital service spent by the 22 general surgeons who received one or more years of their hospital training at the Johns Hopkins was 98 years, an average of 4½ years. That of 8 gynecologists with similar training was 37 years, likewise an average of about 4½ years, while that of 11 obstetricians was 39 years, an average of about 3½ years. The length of service of different individuals varied in surgery from 2 to 8 years, in gynecology from 3 to 7 years and in obstetrics from 2 to 5 years.

With this long hospital service of graduates preparing for surgery may be compared the services of a similar group of 13 men preparing for internal medicine. These men served a total of 50 years, an average of nearly four years, with variations in length of service from 2 to 10 years.

Of the graduates in the surgical group those whose records show the smallest percentage of specialized graduate training belong to the genito-urinary surgeons and the eye, ear, nose and throat specialists. These men undoubtedly have for the most part had a large amount of dispensary training not indicated in the records.

The 40 graduates included in the science group all had, as assistants and young instructors, a large amount of special laboratory training subsequent to graduation. Yet 50 per cent. of them first spent a year or more as clinical internes.

The 10 men now engaged in administrative work all had some special postgraduate training, in most cases including a hospital interneship.

The long course of preparation, four years in college, four years in the medical school and several years of subsequent training for a specialty which marks the career of so large a percentage of those under consideration would lead us to expect to find most of them settled in large centers of population where specialists have the best opportunity to exercise their calling and get return from the heavy investment in time and money. This is the case. The graduates of the first ten classes are widely scattered over the country from Maine to California and from Minnesota to Louisiana but for the most part they are settled in large cities, Baltimore naturally claiming the lion's share, but with a relatively large number in New York, Boston, St. Louis and San Francisco.

TABLE V

Location According to Size of Towns

J. H. U. Graduates, 1897–1906, Practitioners Only

Population of Residence	Total No.	Women	First 5 Classes	Second 5 Classes
	329	33	108	221
1,000,000+	9.4%	15.2%	10.2%	9%
400,000+	30.7	15.2	29.6	31.2
200,000+	16.7	18.2	19.4	15.4
100,000+	11.5	9.1	16.7	9.1
50,000+	10.9	9.1	7.4	12.7
20,000+	6.4	15.2	6.5	6.3
10,000+		6.1	2.8	4.5
5,000+	6.7	3	2.8	2.77
5,000−	6.4	6.1	1.9	8.6
Foreign	1	3	2.8	0.5

Table V. shows the distribution of the graduates engaged in private practise in this country and its dependencies, marked "foreign" in the table, according to the size of the communities in which they are located. From this it may be seen that over two thirds are located in cities of 100,000 inhabitants or over, and relatively few are located in towns of 10,000 inhabitants or less.

The great majority, therefore, are in active competition with first-class men in large centers. How many have made a striking success? This is a difficult matter about which to form a fair judgment. Excellent service may lead to a merely local

reputation while the ability of a mediocre man to get articles into popular weeklies or into the newspaper may lead to inclusion in "Who's Who." In order, however, to get some measure of success I have tabulated (Table VI.) the percentage of those

TABLE VI

Societies and Distinctions

(J. H. U. Graduates, 1897–1906)

Group	Number in Group	Fellows A. M. A., %	Members Spec. Soc., %	Fellows A. C. S., %	Who's Who, %	American Men of Science, %	Starred Individuals, %
General practise without specialization	81	54.3	6.2	0	2.5	2.5	
General practise with specialization	75	72	5.3	0	1.3	4	
Internists	35	91.5	48.6	0	28.6	22.9	2.9
Medical specialties	41	80.5	43.9	0	2.4	14.6	
Total medical	76	85.5	46	0	14.5	18.4	1.3
General surgery	58	88	27.6	60.4	5.2	5.2	1.7
Surgical specialties	36	83.4	47.3	50	8.3	2.8	
Eye, ear, nose, throat	19	89.5	31.6	42.1	5.3	10.5	
Obstetrics	20	80	15	35	5		
Total surgical	133	85.7	31.6	51.9	6	4.5	0.8
Science	40	57.5	82.5		52.5	75	30
Administration	10	50					
Total	415	73.5	28.8	16.6	10.4	13.3	3.4

belonging to various special groups who have been made members of special scientific medical societies, of those who have been included in "Who's Who," and in "American Men of Science," with a special column for those starred as among the first 1,000 men of science. Since the last edition of "American Men of Science" was published in 1910 the scientific standing of the members of the later classes to graduate is not up-to-date. For the sake of comparison I have also shown the percentage of each group who are fellows of the American Medical Association and I have included a special column to show the Fellows of the American College of Surgeons.

The graduates who have taken up a career in science show the greatest percentage of those included in "Who's Who" (52.5 per cent.) as well as in "American Men of Science" (75 per cent.) and in the starred list (30 per cent.). The internists come next (28.6 per cent. in "Who's Who") while relatively few of the surgeons are thus distinguished (6 per cent.). The surgeons represent, on the whole, the strong students with a practical rather than a scientific attitude of mind, while the internists represent a group of strong men with both "practical" and scientific leaning. Taking the whole group of 415 individuals now engaged in medicine we find 10.4 per cent. included in "Who's Who," 13.3 per cent. among "American Men of Science" and 3.4 per cent. among the starred individuals.

For the sake of comparison the following rough estimate[3] may be of interest:

[3] These estimates, necessarily rough, are based on the following data. The population of the country is taken as 100,000,000. The number of males of a given age is based on the ratios given in the last United States census reports. The number of college graduates is based on the ratio between academic and medical students during the last quarter of the nineteenth century and on the assumption that the ratio between the number of living individuals with the M.D. and of those with the bachelor's degree corresponds with this ratio but with somewhat fewer students finishing the academic than the medical course. This gives as a rough estimate 500,000 college graduates, a number probably too high if graduates of regular college courses of the old type are alone counted, too low if the graduates of all sorts of technical courses leading to the bachelor's degree are counted. It is arbitrarily assumed that of the 500,000 graduates, 350,000 are men and the ratios used in estimating the general male population of a given age are used in determining the number of college graduates of a given age, the age of twenty-two being taken as the minimum

TABLE VII.

Adult Males	Est. Number	Per Cent. in Who's Who	Per Cent. in American Men of Science	Starred List
30–39 years of age...	7,700,000	0.029	.015	.003
40–49 years of age...	5,600,000	0.77	.04	.008
Male college graduates:				
30–39 years of age..	91,000	1.18	1.1	.24
40–49 years of age..	65,800	3.2	2.8	.6
Physicians, men:				
30–39 years of age..	44,000	.41	0.8	.15
40–49 years of age..	32,000	1.1	0.8	.15
Second five classes:				
Living men.....	254	3.9	9.1	1.2
First five classes:				
Living men.....	125	25.6	25.6	8.8
Both classes	379	11.1	14.5	3 7

age of those graduates. The number of physicians is estimated from the numbers given in the last edition of the American Medical Directory, an arbitrary allowance of 2½ per cent. being made for women physicians. The number of physicians of a given age is estimated like that of college students but twenty-five is taken for the minimum age. The estimates of the Johns Hopkins graduates are based on actual figures. The numbers of those given in "Who's Who" are taken from the last edition but the age ratio and sex ratios are taken from data given in the 1903–05 edition. The estimates of those included in "American Men of Science" are based on the figures 5,536 for all individuals and 1,201 for starred individuals (269 names being added to the list of 1,000 in the first edition and 68 removed). The age ratios for the thousand leading men given by Cattell in the last edition are used for estimating the number of individuals of a given age in both lists. Since the age of the leading men tends to be higher than that of those not attaining distinction, this method of estimating probably gives figures smaller than the actual figures for those merely included in the total list and possibly also for those who make up the 200 starred individuals in excess of the 1,000 on which Cattell bases his estimates. Since, however, no allowance has been made for the two or three per cent. of women in the lists and for Canadians in the first list, it is probable that the estimates used give sufficiently accurate results for our present purposes. Cattell in his statistical tables shows at what institutions 515 of the first

Since relatively few women are included in "Who's Who" and in "American Men of Science" and only one of the fifty-one living women graduates in our list, we can get the best idea of the relative distinction indicated by inclusion in these two lists by comparing the percentage of men graduates included in these lists with the percentage of other men of similar age thus included. The average age of the men of the first five classes may be taken for "Who's Who" to be from about 40 to 45 years of age and of those included in "American Men of Science" from about 35 to 40 years of age. The average age of those of the second five classes may be taken to be about five years less. Without going here into detail we may say the percentage of graduates of the second five classes included in these lists is about ten times as great as would be expected from them as physicians and from nearly four to eight times as great as would be expected from them as college graduates. The percentage of those of the first five classes included in the lists is from twenty-three to nearly sixty times as great as would be expected from them as physicians and from eight to fifteen times as great as

thousand men of science received their bachelor's degree but he does not give figures showing the number not receiving a bachelor's degree. Pearse in his analysis of the medical group (Science, XLII., p. 277, 1915) shows that about 22 per cent. of those contributing to the medical sciences took no bachelor's degree, although many of these did some college work. Since this group compared with other groups contains a high percentage of investigators who took no bachelor's degree we may take 15 per cent. as an arbitrary proportion in estimating the number of such men and this has been done in estimating the percentage of college graduates included in "American Men of Science" and among the starred individuals. Test counts supported those estimates. The age ratios are estimated as given above. Scott Nearing has recently made a study of 2,000 men in "Who's Who" of about the age of those here studied. *Scientific Monthly*, January, 1916.

TABLE VIII

Relation of Preliminary Training to Careers (J. H. U. Graduates, 1897–1906)

	Total No	Special Groups			Honors			
		Medicine, Per Cent.	Surgery, Per Cent.	Science, Per Cent.	W. W., Per Cent.	Science, Per Cent.	Science Starred, Per Cent.	A. C. S., Per Cent.
New England colleges for men:								
Yale	50	22	36	10	14	18	2	26
Bowdoin	11	9	27.3	9	0	0	0	0
Harvard	11	18.2	18.2	27.3	27.3	27.3	9	9
Amherst	9	11.1	66.6	0	11.1	11.1	0	44.4
Williams	7	14.3	47.2	0	14.3	0	0	42.9
5 others	11	9	54.5	0	0	0	0	9
Total	99	17.1	39.4	9.1	12.1	13.1	2	21.2
Eastern colleges for women:								
Smith	8	0	25	12.5	12.5	12.5	12.5	0
Wellesley	8	12.5	0	0	0	0	0	0
4 others	8	37.5	0	0	0	0	0	0
Total	24	16.5	12.4	4.1	4.1	4.1	4.1	0
North Atlantic:								
Johns Hopkins	67	27	29.9	13.4	14.9	19.4	3	17.9
Princeton	17	5.9	59	0	0	5.9	0	47
Cornell	8	12.5	62.5	0	0	0	0	0
20 others	39	10.3	30.8	2.6	0	2.6	0	20.5
Total	131	18.3	35.9	7.6	7.6	11.5	1.5	21.4
Middle West:								
Wisconsin	22	36.4	22.8	13.6	9.1	18.2	4.6	9.1
Knox	6	16.7	33.3	0	16.7	33.3	0	16.7
Michigan	5	0	20	80	60	60	40	0
Chicago	5	20	20	20	40	60	20	20
Adelbert	3	0	33.3	33.3	33.3	33.3	33.3	33.3
26 others	30	9.9	33.3	9.9	0	6.7	0	16
Total	71	18.3	28.2	16.9	12.7	21.2	7.1	14.1
Far West:								
Stanford	17	5.9	35.4	0	0	5.9	0	0
California	1	18.2	27.3	18.2	18.2	27.3	9	18.2
Total	28	10.7	32.1	7.1	7.1	14.3	3.6	7.1
South:								
Randolph Macon	10	10	40	10	30	10	10	20
N. Carolina	8	25	0	12.5	0	12.5	0	0
Georgia	5	40	40	0	20	0	0	0
Kentucky	5	40	20	20	40	20	20	0
Hamp. Sidney	4	25	25	0	25	0	0	25
19 others	28	25	25	7.7	3.6	10.7	0	14.3
Total	60	25	25	8.3	13.3	10	3.3	11.7
Canada	2	0	0	50	50	50	50	0
Totals	415	16.3	32	9.6	10.4	13.3	3.4	16.6

would be expected from them as college graduates. I have no data with which to compare them with other college men who have taken the medical course elsewhere. It is obvious, however, that an unusual percentage of the men under consideration have attained the kind of distinction which gives one a place in "Who's Who" and in "American Men of Science" and may be looked upon as among the leaders in their chosen fields. Of the graduates of the first two classes about one in three is in-

cluded in "Who's Who," four out of the fifteen in the first graduating class are in the starred list in "American Men of Science."

The relation of ultimate success to premedical college training is of some interest. While I have not time to go into this subject at present in any detail, I may point out in Table VIII. that students coming from the colleges of the Middle West have been particularly strong in science while those from the colleges of the North Atlantic States have been strong in practical surgery but have not gone much into research or other fields leading to a more or less national distinction. It is only by putting the graduates of the collegiate department of the Johns Hopkins in the North Atlantic division that this division is enabled to make a fair showing outside of surgery as compared with the other divisions. Based on its clientele this department might perhaps more justly be placed in the Southern division. Some points brought out by the table are difficult to explain. Why, for instance, should the graduates of the University of California make an unusually good showing from the point of view under discussion and those of Leland Stanford an unusually poor one? Why should the smaller colleges of the South do so much better on the whole than those of the small colleges of the rest of the country?

From the records of the graduates of these first ten classes of the Johns Hopkins Medical School it is clear that their success along orthodox lines has been unusually high. Into this success numerous factors have entered which we need not discuss here but not all of which can we hope to have generally repeated with the elevation of entrance standards and reorganization of methods in the medical schools throughout the country. It is evident, however, that this general reorganization is accompanied by greater scientific productivity in medicine and a greater tendency to specialization than we have hitherto had in this country, accompanied by an increased tendency to settle in large cities. What lessons can we learn from this group of graduates who represent in a way the first product of our present methods of medical education and what deductions can we make as to the directions in which we should guide medical education so as to provide adequately for a generation ahead.

The aim in requiring premedical college training in physics, chemistry and biology and in greatly strengthening the laboratory work in the basal medical sciences has been to qualify men to bring the whole force of modern science to bear on the solution of medical problems. As a matter of fact the main point of view presented to and accepted by the majority of the group of students under consideration when they came to clinical problems was what we may designate as a "looking backward" point of view. The basis on which to found conceptions of a given disease was that of its ultimate ravages in a body incompetent to resist. The course of the disease was to a considerable extent reasoned out from the findings in the autopsy room. Most of the cases seen in the hospital wards were patients in whom disease was far advanced so that the autopsy picture of similar cases was an aid in formulating a picture of the probable appearance of the organs. Even in the dispensaries a large proportion of the patients were advanced cases. Little or no opportunity was given to study the beginnings of disease and the conditions in the individual or the community which produce these beginnings, although, of course, opportunity was given to study specific microorganisms and lectures were given on etiology. Few of the group of graduates

under consideration have gone effectively into the fields of hygiene and preventive medicine, although two have achieved distinction along these lines and one has a world-wide reputation for his work in the Far East and the Near East.

The medicine of the future is certainly to become more and more concerned with the prevention of disease or with the prevention of the spread of disease not only in the community but in the individual and relatively less concerned with its ultimate ravages. Means must be devised for bringing the student in contact with disease in its incipiency both in the community and in the individual and to give a "looking forward" rather than a "looking backward" point of view, opportunity to think of disease in terms of its earliest beginnings and gradual spread, rather than merely to deduce its course from its ravages. The detection of the earliest symptoms requires far more highly trained powers of clinical observation and far more highly skilled laboratory work than does the detection of disease in its later stages. We now expect tuberculosis to be detected before large cavities have appeared or even before the specific bacilli are found in the sputum but how many physicians can do so? The field that lies between chemistry, bacteriology and clinical medicine has been greatly developed since the men we have been considering above received their undergraduate clinical training and offers great help. Modern roentgenology is also of help in early diagnosis. But the undergraduates of to-day will not get opportunity to have practical experience in cultivating these fields if abundant opportunity is not given them for coming into contact with patients in the earliest stages of disease. For this consultation and diagnostic centers, such as have been urged by insurance companies, will have to be extensively established and placed at the disposal of our clinical teachers. To encourage this the public will need some education but there is a greater demand for such centers, I think, than is understood by the medical profession. The need of preventive dentistry has long been understood by the more intelligent classes in this country. Recent developments have shown that in the endeavor to save teeth some dentists have succeeded to the detriment of the general health of the patient and have served to emphasize the fact that specialists must cooperate for the ultimate best results to the patient.

Diagnostic centers used for medical teaching will probably have to be supported by public taxation or by endowments. Similar centers should be open to those who can afford to pay a moderate fee for the services of a group of specialists. Few can afford, or feel they can afford, to go to a series of specialists and pay the fees necessary to keep up a series of special establishments unless disease is so far advanced that the necessity seems imperative. With the development of opportunities to study disease in its incipiency optimistic therapy will more and more take the place of the therapeutic nihilism that haunts the autopsy room.

The development in Europe of social insurance and its beginnings in this country will make the importance of preventive medicine increasingly clear both to the organizers of industry and to industrial workers. Somewhere in the training of our students we must make them acquainted with modern industrial problems so that as physicians they may take a wise leadership in at least the medical aspects of the industrial reorganization which is taking place.

One mistake frequently made should, I think, be pointed out. No sharp line can be drawn between preventive medicine, on the one hand, and curative medicine, on

the other hand. Public health officers can not do thoroughly effective work if they can not apply remedies to diseased individuals as well as to other sources of danger to the public health. By far the most effective public health service in this country to-day is the United States Public Health Service and here treatment of individuals and treatment of environment are carried on hand in hand. The practising physician can not do effective work for his patients if he does not take an active part in promoting public health measures.

From the social standpoint two things in the practise of medicine especially need changing. First we need more organization and cooperation of men in different lines of work in place of the extreme individualism which prevails to-day and is economically so wasteful. Hospitals should be looked to more and more as natural centers where the specialized activities of groups of physicians may be brought into harmonious cooperation and where diagnostic centers for those who can afford to pay, as well as for the poor, may be established and economically run. Hospitals of this kind established in rural districts would do much to make the conditions of rural practise more attractive and to overcome the lack of physicians which in some communities is already serious and will become more so with the decrease in the number of physicians brought about by raising of standards of medical education. A greatly reduced number of physicians in this country can serve the needs of the people effectively only through cooperation. With cooperation it will be possible to serve the community far more effectively than before. It has been estimated for instance that at present in Wisconsin physicians attend women in labor in only 40 per cent. of cases, midwives, usually poorly trained, in 40 per cent. of cases, and no trained persons in 20 per cent. of cases. With the establishment of more hospitals and the use of automobiles practically all women might be given opportunity to bear children amid good surroundings and under skilled care, with untold good to the public. Rural nurses in connection with the rural hospitals and visiting nurses in connection with the city hospitals add greatly to their effectiveness.

Besides the need of more effective organization and cooperation there is a need of a reorganization in medical economics. The public should pay for the public services which physicians perform. The evil of extracting a large amount of service for little or nothing is especially marked in the large cities where young physicians are encouraged to do a large amount of dispensary work for "experience." The Robin Hood method of subsequently making the rich pay fees sufficient to cover the services rendered the poor is economically wrong. Public service should be paid for by the public to the medical as well as to the legal profession.

The expenses connected with the early years after graduation as well as the cost in time and money of the long training now demanded of medical students makes it imperative that we should seek to lessen the cost to the student in every way compatible with efficient training. Otherwise we shall limit the profession too much to a restricted class of the well-to-do. By making the relative proportion of the cost of the investment represented by a medical education unduly high to the student we shall encourage him subsequently to become commercialized, to forget that the public and teachers are stockholders in the investment and to make his chief aim in practise the greatest possible financial re-

turn to himself. With the profession confined to a few high-priced practitioners there will be danger of increased quackery for the mass of the people.

If we try to reduce expense by educating large numbers in relatively few medical centers, as seems to be advocated by those in charge of the investigations of medical education for the Carnegie Institutions, I believe that effective results will not be obtained because intimate association between teacher and pupil is necessary for effective training in a complex field like medicine and this becomes difficult or impossible when students are thought of in large masses rather than as individuals. Our schools with the largest endowments and best facilities are thus coming to limit the number of students received in each class. The tendency to encourage students to get the premedical work in academic colleges and the growing number of institutions giving the first half of the medical course show us ways of keeping the number of students taking the preliminary scientific training for clinical medicine restricted to relatively small groups the members of which can receive considerable individual attention. There are two chief difficulties at present connected with this part of the work. First, work in the preliminary sciences at the larger colleges and universities is given to such large classes and sections that individual instruction is hampered unless special sections with special instructors are provided for the premedical students. Second, the premedical work in the sciences is practically always given and the work in the fundamental medical sciences is to a greater or less extent given by men who have not had a medical education and are not intimately acquainted with medical problems. While the fundamental sciences should be taught from a broad point of view and not be restricted to a special aspect thought by the teacher to be all that is necessary for medicine, the training in the basal sciences should be such as to fit the student as simply and directly as possible to view medical problems from the point of view of physics, chemistry and biology and the more specialized sciences. That medicine can be thus viewed from these various points of view will be best appreciated by the student if he is thrown with teachers capable of doing so. Those who administer preclinical courses should keep this fact in mind. If it is kept in mind there is no reason why there should not be gradually established in the country a considerable number of effective preclinical courses where the student can get an effective training for clinical work. Compared with ordinary college courses such courses will be expensive but viewed from the standpoint of their value to society they should be of great value.

The clinical part of medical training presents a more difficult problem. At present the tendency is to devote about one third of the second year and all of the third and fourth years of the four-year medical course, and an interne year to clinical training. The premedical and preclinical medical work takes up the major part of our ordinary four-year academic college course. In addition we require three further years of clinical study, as much time as is required of a college graduate for a Ph.D. degree. The graduate student has opportunities for teaching fellowships sufficient to cover at least the cost of living. The medical student is required to pay large tuition fees in addition to his living expenses except during the interne year when he is relieved of the tuition fee and gets room and board for his services

to the hospital. Students are encouraged to believe that they can get adequate clinical training only in large cities and that the most valuable interneships are in the larger hospitals in these cities. Clinical teaching thus becomes to a large extent mass instruction. Intimate relations between individual students and individual teachers become difficult even during the interne year.

The old apprenticeship system in medical education had some marked advantages which present system of mass instruction lacks. Is it not possible to restore some of the advantages of the old apprenticeship system without loss of modern scientific training? Can we not utilize a large number of clinical centers for clinical teaching and a large number of progressive men as teachers instead of restricting clinical teaching to a few men connected with large hospitals adjacent to medical schools in large cities?

I believe this can be brought about by encouraging a greater number of practising physicians to qualify for the term doctor in its original sense of teacher. Why should not our medical students after two years of premedical college work and two or three years in the medical school be qualified to reside in hospitals, for the most part small hospitals, where they could earn board and room by helpful work about the place and at the same time study under the immediate supervision of members of the hospital staff. Such hospitals should provide diagnostic centers along the lines outlined above. If a few students thus acted as clinical clerks in a series of hospitals during the course of two or three years following the present second or third year in the medical school they could get a broad experience in direct contact with medicine as it is best practised at the present time. Variations in the types of hospitals would secure training in the varied lines of medicine. Each student would come in intimate contact with a considerable number of active progressive men whom he would stimulate and some of whom would in turn inspire. Only hospitals of a certain grade would be recognized for this service and this in turn would serve to stimulate hospital development. The immediate clinical facilities of the medical school could be utilized for supplementing and strengthening the extra-mural hospital service and the clinical staff would have supervision of the clinical teaching in the hospitals and give the final examinations. The expenses of the medical course would be reduced and the public would profit from a more direct training of its practitioners. Furthermore, this system would help to overcome one of the greatest dangers of our present system of education, the destruction of originality through too many years of subordination of personality to mass domination by teachers. It would tend to produce independence in the students.

Such a plan may not, of course, be best for all schools but it may for some. As an association let us maintain the scientific ideal in medicine but let us not carry standardization too far. Let us encourage different methods of reaching the results at which we all should aim, the establishment in our students of habits of independent accurate observation, of judgment based on knowledge of fundamentals and of skilled execution based on practical experience, and then let us study the results as scientifically as possible and base our changes in methods so far as we can on observed facts.

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THE FOREST SERVICE

The annual report of the forester of the Department of Agriculture made public on

December 21 comments on the government ownership of water-power sites and timber as exemplified by the national forest system. The financial burdens resting on private owners of uncut timber are held to have forced the manufacture of lumber without regard to market demands, and with consequent demoralization of the lumber industry and wasteful use of timber resources; while facts and figures regarding the water power situation are given to prove that more rapid development of water power in the west is mainly prevented by the lack of consumers, rather than by the absence of suitable legislation.

Water power permits taken out for National Forest projects, says the report, involve a total of 1,261,560 horsepower. Free permits cover 70,628 horsepower and the plants actually constructed or operating June 30 had an output capacity of 341,276 horsepower, the rentals paying $89,000 during the year. The report comments on the water power situation as follows:

New legislation permitting the government to grant a more secure tenure for the lands used, through the issuance of fifty-year leases, would, without doubt, make the financing of power developments on the public lands both easier and cheaper, and is very desirable; but the main obstacle to more rapid development than that which is now taking place is not lack of a new law but lack of a broader market for power. It is at least doubtful if either an amended law or private ownership of the public power sites would result in any general or material increase in power development in the western states in the immediate future. With rare and minor exceptions, existing power developments in these states are far in excess of market demands. The Forest Service is being constantly importuned to extend periods of construction on power permits on the plea that there would be no market available for the power if the project were developed. The per capita use of water power in electrical development in the three Pacific and the eight Mountain states is far in excess of that in any other section of the United States, and more than five times the average for the United States, as a whole. The development of the Pacific States is about 180 horsepower, per thousand of population, and in the Mountain states 120 horsepower, with a balanced average of 160 horsepower. New England, which is next in order, has less than 40 horsepower per thousand of population, and the whole United States about 30 horsepower.

The report goes on to say:

The drop of thirty per cent. in the demands for national forest stumpage, as indicated by the falling off in new sales, is a significant index of the unstable market for lumber and the serious conditions now obtaining in the forest-using industries.

These conditions which are now the subject of a special study conducted by the Department of Agriculture in cooperation with the Federal Trade Commission and the Bureau of Foreign and Domestic Commerce

are related primarily to the carrying of enormous quantities of raw material, exploitable only during a long period of time, in private ownership. This load of uncut timber, with its far-reaching financial burdens, hampers or prevents the private operator from adapting his business to the changed conditions of his market and to the competitive factors of more or less recent development. Hence a tendency toward a lumber output governed not by the requirements of the country, but by the financial necessities of the owners of stumpage, with its resultant market demoralization and wasteful use of timber resources. Had the national forests never been created, the conditions of trade depression and wasteful exploitation, detrimental alike to the interests of the lumber industry and the public, would have been markedly accentuated. The value of public ownership of a considerable part of the timber resources of the nation has never been demonstrated more strikingly than by the results of private ownership now manifest.

Although large commercial sales fell off, due to the depressed condition of the lumber market, says the report, the number of sales to settlers, farmers and small dealers at cost rates nearly doubled in number, while more than 40,000 free timber permits were issued, an increase of 549. The steady increase of this use, the forester adds, indicates the importance of the national forests to the communities in which they lie and the stability of the local demand for their products.

The report discusses in detail the work of the Forest Service during the fiscal year ended June 30 last, showing a general increase

in all forest activities except commercial timber sales. It predicts, however, a large revenue from all sources for the fiscal year 1916, the general improvement in business conditions throughout the country having been already felt in the national forests, as shown by an increase during the first three months of about $119,000 over the earnings of the same period last year. During the fiscal year, the total revenues were $2,481,469.35, an increase of $43,759.14 over 1914. Of the $5,662,094.13 provided by the regular appropriation for the Forest Service, says the report, $5,281,000 was expended for protection, utilization and improvements, the cost of protection being increased by an extraordinarily severe fire season which necessitated emergency expenditures that were partly provided for by a deficiency appropriation of $349,243. An additional sum of about $196,000 was spent under the law which permits 10 per cent. of the forest receipts to be employed in road development for the public benefit.

The expenditures include, says the report, the protection of resources which as yet can not be made to bring in cash returns, such as inaccessible timber, as well as those, such as watershed covering and recreational advantages, which yield great general benefits not, however, measurable in money values. In this connection, the report mentions that timber given free to settlers and others was worth more than $206,000, while that sold under the law at cost was worth $33,000 more than the government got for it. The revenue also foregone by allowing free use of certain grazing lands, adds the report, is estimated to exceed $120,000, while a moderate charge for privileges that are free would bring in at least $100,000 more. All this, says the forester, has never been entered on the credit side of the Forest Service ledger.

SOIL SCIENCE

Soil Science is the title of a new monthly journal which is published under the auspices of Rutgers College. The journal, which is international in its scope, is devoted exclusively to problems in soils, including soil physics, soil chemistry and soil biology. Dr. Jacob G. Lipman, of the New Jersey Agricultural Experiment Station, is editor-in-chief, and has associated with him a consulting international board of soil investigators. This group consists of twelve of the leading authorities on soils in the United States and eleven from foreign countries.

It is believed that the journal will fill a distinct need in the field of modern science. Soil investigators have long felt the necessity for a specific medium for the publication of their research work. Heretofore, they have found it necessary to resort to journals not specifically devoted to soil problems. Consequently, they have been put to much inconvenience in keeping before them all the more important papers in soil research. Moreover, they have found it increasingly difficult to secure the prompt publication of their own papers in journals whose contributions cover a wide range of scientific activity. In planning for the publication of *Soil Science,* the editor was guided by the wish to facilitate the bringing to light of the results of soil research. He felt encouraged to believe that the new journal would help to conserve the time and the energies of his fellow students of soils, that it would provide for a more direct contact among men interested in the same problems, and that it would lead to a broader outlook on the entire field of soil fertility.

THE ECOLOGICAL SOCIETY OF AMERICA

A meeting of ecologists was held at Columbus in convocation week to take action upon the proposal made at the Philadelphia meeting for the formation of a society of ecologists. Over fifty persons were present and the organization committee held letters from about fifty others who expressed interest in the project. In view of these facts it was unanimously voted to organize under the name The Ecological Society of America. It was decided to enroll as charter members not only those present at the organization, but also those who had by letter expressed a desire to be included in the membership, as well as those joining prior

to April 1, 1916. A constitution which had been drafted by the organization committee was adopted, and the following officers were elected: President, Professor V. E. Shelford, of the University of Illinois; vice-president, Professor W. M. Wheeler, of Harvard University; secretary-treasurer, Dr. Forrest Shreve, of the Desert Laboratory. The first regular annual meeting will be held in New York during the next convocation week, where a program will be arranged in harmony with the programs of other societies, so as to minimize serious conflict. Frequent field meetings will be held under the auspices of the society—four having already been arranged for the coming summer. Several proposals for the carrying out of cooperative investigations are also being entertained by the members of the society.

SCIENTIFIC NOTES AND NEWS

A BANQUET will be held in commemoration of the one hundredth anniversary of the organization of the United States Coast and Geodetic Survey on April 6, at the new Willard Hotel, Washington, D. C. The speakers will be: the President of the United States, the Swiss minister, the secretary of the navy, the secretary of commerce and Dr. Thomas Corwin Mendenhall.

THE American Chemical Society will hold its annual session at the University of Illinois from April 17 to 21. On April 19, in connection with these sessions, the new chemistry building of the university will be dedicated. The equipment for the new laboratory is arriving daily and is being installed as rapidly as possible to facilitate the preparation for the dedication of the building. At the dedication exercises Governor Edward F. Dunne will preside and deliver an address. Other addresses will be given by Dr. W. R. Whitney, of the General Electric Company and a member of the U. S. Naval Board, and Professor Alexander Smith, of Columbia University, by President James and others.

DR. L. O. HOWARD, chief of the Bureau of Entomology, U. S. Department of Agriculture, will give the evening lecture at the general meeting of the American Philosophical Society, on the evening of April 14. The subject will be "On Some Disease-bearing Insects."

THE Avogadro Medal has been awarded to Professor H. N. Morse, of the Johns Hopkins University, for the most important contribution to molecular physics made since the meeting held in Turin in 1911, to celebrate the centennial of the announcement of the hypothesis of Avogadro.

THE Illinois Academy of Science has elected the following officers for the ensuing year: *President,* Dr. William B. Trelease, head of the department of botany, University of Illinois; *Vice-president,* Dr. Griffith, of Knox College; *Secretary,* Dr. J. L. Pricer, of Normal University; *Treasurer,* Dr. H. S. Pepoon, of the Lakeview High School of Chicago.

DR. KARL SCHWARZSCHILDT, director of the Astrophysical Observatory at Potsdam, has been given an honorary professorship in the University of Berlin.

PROFESSOR KARL GRAEBE, professor of chemistry at Geneva from 1898 to 1910, discoverer with Liebemann of artificial alizarin, has celebrated his seventy-fifth birthday.

PROFESSOR O. C. GLASER has been appointed director of the Biological Station of the University of Michigan.

THE Associated Geological Engineers have opened a New York office in charge of Frederick G. Clapp, managing geologist of the petroleum division.

THE University of Toronto has granted Velyien E. Henderson, associate professor of pharmacy and pharmacology, leave of absence on his appointment as major in Canadian overseas expeditionary force.

DR. E. W. OLIVE, curator at the Brooklyn Botanic Garden, sailed on February 19 for Porto Rico to study and collect parasitic fungi and other plants.

MR. AND MRS. ROY CHAPMAN ANDREWS are leaving on an expedition to southern China to make collections of mammals for the American Museum of Natural History.

The Washington Academy of Sciences has arranged a series of evening lectures dealing with various phases of the war. On March 2, Dr. Douglas W. Johnson, of Columbia University, addressed the academy on "Surface Features of Europe as a Factor in the War." The second lecture of the series, entitled "Chemistry in Relation to the War," will be presented by Dr. L. H. Baekeland on March 23. Through the courtesy of the secretary of the Smithsonian Institution the large auditorium of the new National Museum has been placed at the disposal of the academy for this series of lectures.

President Charles R. Van Hise, of the University of Wisconsin, gives the Sigma Xi address at the University of Minnesota on March 17.

On February 25, Professor George Grant MacCurdy lectured at Bryn Mawr College on "The Origin and Evolution of Ornament in Art."

Dr. Vera Danchakoff, of the Rockefeller Institute, addressed the seminar in zoology of the University of Pennsylvania, on February 29, on the subject of "Experimental Modification of Hematopoiesis in the Chick Embryo."

Dr. Herbert V. Neal, professor of zoology at Tufts, is giving a series of lectures on "The Organic Evolution of Life" in Tremont Temple, during March and April.

Dr. Willis T. Lee, of the United States Geological Survey, will give an illustrated lecture on April 7 at Lehigh University on "Camp Life of a Geologist in the Rocky Mountains."

A course of five lectures, with accompanying laboratory demonstrations, was given by Dr. Fred. E. Wright, petrologist, Geophysical Laboratory, Carnegie Institution of Washington, before the Department of Geology of Columbia University from February 28 to March 3. Dr. Edgar T. Wherry, of the United States National Museum, gave before the department on March 8, two lectures on petrographic methods.

During the coming summer session of the University of California, from June 26 to August 5, three graduate seminars will be offered in the department of chemistry: "Recent Theories Concerning the Nature of Free Radicals, Oxonium and Carbonium Salts," Professor M. Gomberg, of the University of Michigan; "Colloids and Surface Tension," Professor J. H. Hildebrand; "The Calculation of Free Energy," Professor G. N. Lewis.

Dr. William L. Rodman, this year president of the American Medical Association, professor of surgery at the Medico-Chirurgical College of Philadelphia, died on March 8, aged fifty-eight years.

UNIVERSITY AND EDUCATIONAL NEWS

In the will of Robert R. Rhodes, of Cleveland, Western Reserve University, through its medical school and affiliated institutions, is a beneficiary to the amount of about half a million dollars. There was given to Lakeside Hospital, $250,000; to Charity Hospital, $50,000; to St. Alexis Hospital, $50,000; to the School of Medicine, $50,000; to the Babies' Dispensary and Hospital, $25,000; to the Tuberculosis Free Dispensary, $25,000, and to the Maternity Hospital, $25,000.

The will of Marie Antoinette Fisk, of Pasadena, Cal., gives $50,000 to Princeton University for the construction or improvement of dormitories.

Fire on March 5 completely destroyed the new engineering building and shop buildings of the Michigan Agricultural College at East Lansing, with a loss of about $240,000. Most of the engineering, shop and physics equipment was lost, as were also the records, notes and libraries of the teaching staff.

Miss Sarah Holborn has bequeathed £1,000 to the London School of Medicine for Women.

We learn from *Nature* that a friend of the late Dr. Donaldson, master of Magdalen College, Cambridge, has endowed a bye-fellowship of the annual value of £100, to be called the Donaldson Bye-Fellowship, in memory of the late master; the fellowship is intended for the

encouragement of research, and is tenable for one year. The financial board reports that Sir Eustace Gurney has offered to present to the university a farming estate of about 257 acres with a view to the encouragement of the study of forestry in the university; the net income in rent of the estate is about £100 per annum. The general board of studies reports that the council of the Royal Geographical Society has decided to make grants of £300 per annum for five years to the schools of geography in Oxford and Cambridge.

THE trustees of Columbia University have voted to admit women to the College of Physicians and Surgeons.

ELMER GEORGE PETERSON, A.M., Ph.D. (Cornell), was elected president of the Utah Agricultural College, on March 17.

DR. ROSWELL C. MCCREA, dean of the Wharton School and professor of economics in the University of Pennsylvania, has accepted a professorship of economics in Columbia University.

AT the University of Cambridge Mr. H. H. Brindley, of St. John's College, has been appointed demonstrator of biology to medical students, and Mr. C. Warburton, of Christ's College, demonstrator in medical entomology.

DISCUSSION AND CORRESPONDENCE

"SCIENTIFIC AND APPLIED PHARMACOGNOSY"

TO THE EDITOR OF SCIENCE: Since the publication of my review of Professor Henry Kraemer's "Scientific and Applied Pharmacognosy," which was written at your request, I have received a letter from my Philadelphia colleague charging me with misrepresentation and other acts of unkindness. In reply I informed him that I was exceedingly sorry to learn that I had offended him and begged him to inform me where I had erred. This he has done in a second letter. I should be glad to have you give the readers of SCIENCE an opportunity to judge for themselves if I have been guilty of misrepresentation, even though quite unintentionally.

One of my statements to which Professor Kraemer makes objections is the reference to failure to give credit to Tschirch's "Handbuch der Pharmacognosie" in his preface, viz.:

> One point, however, is noteworthy as a curious omission. Among the works consulted, the author in his preface does not even mention Tschirch, or his predecessors Flueckiger and Hanbury.

The part of the preface to which I had reference reads as follows:

> In the preparation of a book like the present it is self-evident that it is based upon the work of the great masters who have developed pharmacognosy from its inception. Among the works consulted by the author, and of which special mention should be made, are the following: . . .

Here follow a number of names and titles, those of the three scientists mentioned above being conspicuous by their absence.

Justifying this omission, Professor Kraemer points out in his letter that

> On p. 1, I give Flueckiger's definition of pharmacognosy, and refer to my article in the footnote in which I have credited both Flueckiger and Tschirch with the great work that they have done. In this article I say:
>
> Just now Tschirch's monumental work, "Handbuch der Pharmakognosie," is about being completed and excels anything that has heretofore been published not only in pharmacognosy, but in any department of pharmacy. This work, when it is completed with the other agencies which have been at work, will do much to establish pharmacognosy as a direct[1] science and direct attention of scientists generally to its particular rôle.

The above quotation, however, is not to be found in the book, but is taken from a pharmaceutical journal to which reference is made in the footnote referred to, viz.:

> Henry Kraemer, "The Rise and Development of Pharmacognosy," *Pharm. Era*, Oct., Nov. and Dec., 1912. In this article there occurs citation of the important literature of the subject.

No doubt, as reviewer I should have traced this footnote attached to the definition of the word pharmacognosy and have plodded through three numbers of the *Pharmaceutical Era* in order to ascertain that Professor Kraemer had some time and somewhere expressed his appreciation of both Flueckiger and Tschirch. But whether Professor Kraemer appreciated the

[1] Presumably should read an exact science.

work of these masters or not was not at all the question. The fact remains that in the preface in which Vogl, Collin and others are referred to as the "great masters" and their treatises referred to as sources used in the compilation of Professor Kraemer's new book, the names of Flueckiger and Hanbury and that of Tschirch are conspicuous by their absence. That Professor Kraemer might have had a particular motive in omitting these names I had no thought of suggesting. That I merely referred to their absence as a "curious omission" ought to free me from the suspicion of any intended unkindness. As reviewer I could scarcely have said less. That later in the text two special references occur to Tschirch's "Handbuch" and that other references can be found to journal articles by Tschirch and his students does not alter in any way the failure to give credit to Flueckiger and Hanbury and to Tschirch as general sources of information, among which even the English translation by the writer of Gildemeister and Hoffmann's treatise "The Volatile Oils," and other special treatises are enumerated.

The writer had no intention to intimate that Professor Kraemer was ignorant of the master pharmacognocists referred to, for such intimation would appear ridiculous to all who know how well posted Professor Kraemer is. Neither was it the writer's intention to intimate that the omission was intentional, for all who know Professor Kraemer also know that he could impossibly be guilty of anything that had but a mere suspicion of dishonor. If reference was had to the omission at all it was, no doubt, because it seemed well nigh impossible even to an amateur, much less to one so well informed and careful as Professor Kraemer. That it did occur merely shows that even the best of us will make slips of omission, if not of commission, with our editorial pens.

That the writer should have offended a colleague of whom he has always thought highly he regrets very much. The real reason for sending you this communication is not that I desire to justify my statement, but that it gives me the opportunity to correct any unfavorable impression which my statement may have made upon the minds of those who have thought my review worth reading.

Professor Kraemer also objects to my relation in paragraphs two and three and adds

> I am at a loss to know to what you refer as apparently you have not understood my position from the beginning.

Under the circumstances I greatly regret that I ventured to write the review as requested. One thing I am certain of, namely this, that I had no intention to hurt Professor Kraemer's feelings any more than to misrepresent him. If I were not absolutely positive of this I should more than willingly apologize to my Philadelphia colleague.

Trusting that for Professor Kraemer's sake you will kindly supplement my review with this letter.

Edward Kremers

FROGS CATCHING BUTTERFLIES

I have seen common green bullfrogs, *Rana catesbiana*, catch and eat butterflies—the large, yellow and black, swallow-tailed *Papilio turnus*.

On our summer place in southern New Hampshire there was a brook where the horses were watered. In this pool there were many bullfrogs, and they were not very wild. Passing the watering place one bright, hot day in August, I saw a bevy of perhaps a dozen butterflies fluttering low over the bare, moist ground near the stream. They flew in an aimless and weak fashion not characteristic of this species, and occasionally settled upon the ground, about three feet from the water's edge.

Out of the water crept four big green bullfrogs. They went after the butterflies in the stealthy manner of a cat stalking a mouse. They did not hop or jump, but walked, or crawled, on all fours, flat on the ground—sometimes advancing rapidly, sometimes stopping short with one leg stretched out far behind. Their bodies were strained and quivering, and their interest in the pursuit did not lag for an instant.

When a frog was within a foot of a butterfly it jumped upon it and caught it in its mouth. They ate the butterflies very quickly,

swallowing them whole. I did not see a frog lose one, and I saw one frog catch and eat five. The butterflies seemed to make no effort to get away from them. Occasionally one would alight upon a frog's back. In about half an hour all but one of the butterflies had been caught. The frogs did not try to catch that one. It flew away, and soon three of the frogs went back into the water. The fourth one was apparently too "stuffed" to move.

For many days after this occurrence I watched the watering place, hoping that I might be able to get a photograph of the frogs and butterflies, but I did not see them together again.

I have consulted the best authorities on frogs, and I do not find such an instance recorded.

ALICE MAVOURNEEN MALLONEE
STRATTON, ME.

THE ALLEGED INSTINCTIVE FEAR OF SNAKES

TO THE EDITOR OF SCIENCE: Mr. T. B. Dabney's interesting letter on the "Serpent Instinct in Man," appearing in your issue of the seventh, proposes an argument substantially as follows: The fear of serpents in man is practically universal; therefore it must be instinctive. If instinctive, it must survive from a period when the serpent was a menace to the perpetuation of the human race. But such a period can only have existed before man had clothing. Therefore, it existed before his evolution from the brute was complete. But the principal locality in which man, at such a stage of his history, would have had cause to fear extinction by serpents, is India. Therefore India is probably the cradle of the human race.

To what extent the successive conclusions are supported by their premises it is not my present purpose to discuss. I have but one point to make, and that is that the fear of serpents is probably not instinctive at all. I believe it to be the result of erroneous education in childhood, perhaps accentuated by a certain timidity with regard to wild animals in general, resulting from the protected habits of civilized life.

That the fear of snakes is very general is a fact painfully present to many who, like myself, are studying herpetology with a view to protecting our useful snakes from extermination, and our country from the incalculable losses to agriculture which would thence ensue. The desire to justify the aforesaid fear is mainly responsible for the persistence of a mass of absurd superstitions about even the commonest species of snakes. But the prevalence of this attitude is not, in my judgment, sufficient reason for attributing it to an instinct of self-preservation which was the property of a supposititious brute ancestor of man, and has consequently defied the efforts of education to dislodge it, at least when there is question of first impulses. As a matter of fact, there is an equally general aversion to toads, lizards, spiders, worms and other animals possessing unpleasant qualities. The sudden presentation of such objects produces even the "panic of horror" alluded to, in quite as many instances as the sight of the serpent. And yet, none of the other creatures mentioned can at any time have menaced the existence of the human race.

If Mr. Dabney's arguments were quite conclusive, he would be well warranted in selecting India as the birthplace of herpetophobia. He is quite correct as to the mortality annually due to serpents in that country. Its immediate cause is well known to every one acquainted with conditions there. The natives of India are frequently bitten by venomous snakes because, despite all the efforts of their European masters, they insist upon going barefoot, even when otherwise well clad. If it was the adoption of clothing which first made our primitive ancestor realize that he had an even chance in the struggle for existence, one would surely expect the essential constituent of costume in India to be a pair of boots, whatever else might be wanting.

But there is positive evidence against the theory that the dread of snakes is instinctive. First, there is the common tendency of young children to play with a bright-colored snake, as they would with any toy. An innate horror of snakes as an attribute of the human species is quite inconsistent with such a fact as this.

It is frequently observed; but its first occurrence in any individual case is usually its last. For if the child's mother or nurse be at hand, there ensues a scream of terror, a mad rush to a safe distance, and a frantic admonition, perhaps even a punishment, all of which is quite enough to make a reptile thenceforth an object of fear to the child. This is where the mischief is done. The fear thus early instilled prevents investigation; lack of investigation protects ignorance; ignorance in turn corroborates the initial fear, and thus the destruction of every serpent, large or small, becomes almost a part of the average person's moral code.

In the second place, there are not a few persons who have never in their lives experienced the aforesaid horror of snakes. I am not appealing to cases where fear has been overcome by education, but to those in which the confidence born of natural curiosity has never been destroyed by positive fear instilled in early life. I have known several persons of this class, three of whom, by the way, were women, and thoroughly normal women at that. One of these last is worthy of mention in connection with her brother. This gentleman, with whom I am intimately acquainted, remembers his first sight of a snake, when, at the age of six, he and his nurse almost trod upon a small water snake in a meadow. He still recalls how utterly puzzled he was at the terror with which his nurse hurried him away from the spot, and how entirely free he was from sharing her sentiments. A little later, in early boyhood, he developed an interest in snakes which led him to hunt them in the woods and bring them home in order to watch their actions. His sister, who was even younger than he, accompanied him and sometimes helped him in this pursuit. Their father, a physician, knowing that no venomous snakes could be found in the neighborhood, not only did nothing to dissuade the children from handling snakes, but gave them little points of information and other assistance in this amusement, which they had begun without any suggestion from him. The boy, now a grown man, and a collector of some experience, has acquired an intelligent caution in capturing large snakes, owing to several experiences with their teeth; but he has never in his life felt the slightest approach to an impulse to shrink from even the largest serpent as an object of horror and aversion.

I am persuaded that any one who cares to inquire into this subject will find other cases of a similar nature, and in sufficient number to acquit his fellow-mortals of anything like a brute instinct to shrink from the serpent kind.

W. H. McClellan, S.J.

Woodstock, Maryland

Under the above caption, in Science for January 7, at pages 25 and 26, an argument for India as the cradle of the white race is based upon what the author calls the "instinctive horror of serpents." The evidence concerning such an instinct is altogether too unsatisfactory for one to assume that the horror is instinctive and it is by no means confined to the white race or universal within the white race. In addition, who knows that poisonous serpents were as abundant in India in the infancy of the white race as they are now? To what extent is their present abundance the result of the Buddhist inhibition against their destruction? Surely this inhibition must have had a very considerable influence, and just as surely it does not date back to the birth of the white race. Until it can be shown that the horror of serpents is instinctive and that poisonous reptiles were as abundant in India ages ago as they are now, the argument for the Indian origin of the race, based upon such a supposed instinct, can receive scant consideration.

Indians in northern New Mexico have been known to flee from archeological excavations because of the presence of a small, harmless lizard, which they consider deadly, and to refuse to return until the lizard had been caught and bottled. There is not the least evidence that this indicates an instinct arising from ancestral residence in a region inhabited by poisonous lizards. Poisonous lizards are at present too restricted in range and not abundant enough anywhere to constitute a menace,

and we have no evidence that they were ever more abundant or widely distributed. No one believes that the Indians originated in the region now inhabited by the poisonous lizards.

One who has seen young children playing with snakes, even with rattlesnakes, may well be skeptical about an instinctive horror of serpents. Mothers in some regions have found it advisable to deliberately teach their children to fear snakes, in order to prevent them from handling the dangerous species. In other cases the fear probably comes from association with those who had acquired the serpent horror. On the other hand there are many boys and men, and some women, who seem to be quite devoid of any such horror. The argument that one unexpectedly brought into close proximity to any kind of a snake "is suddenly seized with a panic of horror and fear," has very little weight, because it is not universally so and the same is usually the case when one is brought suddenly into close proximity with almost any kind of an animal. Does woman's proverbial fear of a mouse indicate an instinct engendered by ancestral residence in a region where such small animals were dangerous? Many beginners in biology exhibit as much horror of a worm or a caterpillar, in proportion to its size, as of a serpent.

The "instinctive horror of serpents" does not appear to be established by satisfactory evidence.

JUNIUS HENDERSON

TO THE EDITOR OF SCIENCE: Mr. Dabney's very interesting letter in SCIENCE for January 7, 1916, leads me to inquire: if the fear of snakes, by man, is an indication that there were many snakes surrounding him in primitive days, what does the fear of Indians by the American mule indicate? Was the mule developed in a region where he was surrounded by wicked Indians who abused him?

Frémont mentions this abnormal fear of Indians on the part of our ordinary mules and it has been noted by others, including myself. Frémont says:

> A mule is a good sentinel, and when he quits eating and stands with his ears stuck straight out taking notice it is best to see what is the matter.

For my part I noticed that our mules were as good as or better than most watch-dogs in giving warning of the near presence of Indians. Often before Indians were either seen or heard by any of our party the mules would snort with terror, halt, shy about, and "point" in the direction of the Indian with ears sharply bent forward and a general activity that might land a poor rider on his head. Now, why was the mule so much more afraid of Indians than horses were? I do not remember any of our horses being in the least frightened. Perhaps it was the smell of the Indian the mule detected, for their scent is very keen, but if it was the scent, why did the scent disturb them?

When we had Indians travelling with us, as was frequently the case, the mules became accustomed to their presence and were apparently unmindful of them, yet when an Indian was assigned to ride a mule there was a circus at once and it took half the camp to get him on. Once on, however, the mule being always a mighty wise being, ceased his antics and was calm as a kitten till the Indian got off and tried to remount, when we had the circus all over again. No human being can fathom the wisdom of the mule, of that I am positive, but possibly some reader of SCIENCE may be able to explain the mule's fear of Indians by some other hypothesis than that the Indian was cruel to him in the mule's original, primitive, habitat. Finally, if the fear of snakes designates the location of our primitive home where was the primitive home of the mule reasoning from his fear of Indians?

F. S. DELLENBAUGH

NEW YORK

SCIENTIFIC BOOKS

Robert of Chester's Latin Translation of the Algebra of Al-Khowarizmi, with an Introduction, Critical Notes, and an English Version. By LOUIS CHARLES KARPINSKI, University of Michigan Studies, Humanistic Series, Vol. XI. New York, The Macmillan Company, 1915. Pp. viii + 164. Price $2. In mathematics, as in art, letters, religion,

and the other domains of human activity, there are a few great classics which stand out as monuments to the world's progress. Such are the "Elements" of Euclid, the work of Apollonius on conics, the "Arithmetic" of Diophantus, "La Géométrie" of Descartes, and others of their kind, works upon which rest the great structure of modern mathematics. Among these classics stands and must always stand the first work which bore the name of algebra, the *algebr w'al muquabala* of Al-Khowarizmi, a scholar working at the court of the caliphs at Bagdad although bearing the name of his native state, Kharezm, the country about the modern Khiva. This treatise was written about the year 825 of our era, and although the world had an algebra of one kind or another for many centuries before the era of the "Arabian Nights Tales," it was Al-Khowarizmi who first set forth the science in a treatise bearing the name with which we are familiar.

Like so many Arab productions, the works of Al-Khorwarizmi attracted the attention of scholars in that remarkable period of the awakening of Europe from a long intellectual slumber, the twelfth century. First there was his arithmetic, which was translated by John of Seville as the "Liber algorismi" (Book of Al-Khowarizmi), a title from which we have such words as *algorism* (algorithm) and *augrim*. This work did much to make the Hindu-Arabic numerals known in Europe, and to it is due the name given to the algorists (*algoristi*), those who computed by these numerals instead of using the medieval counters. In the nature of things, the algebra was a less popular work, although it was more or less familiar to scholars from and after the middle of the twelfth century. Of the translators who assisted in making known the science of the Arabs to the scholars of the West, Gherardo of Cremona and Robertus Cestrensis (Robert of Chester) are among the best known, and each appears to have translated the algebra of Al-Khowarizmi. There seems also to have been another translator of this work, not to speak of Leonardo Fibonacci who has a chapter upon "Aljebra et almuchabala" in his "Liber abaci" (1202). This translator was William of Luna, and it is possible, as Professor Karpinski points out, that it is his version which was found by this reviewer some years ago in a manuscript in the library of George A. Plimpton, Esq., of New York.

Of these translations one had appeared in print before Professor Karpinski undertook his work. This is the translation attributed to Gherardo of Cremona, published about eighty years ago in the appendix to Libri's "Histoire des sciences mathématiques." Robert of Chester's translation, which has now been made available for us, had been described by Wappler from two codices (Dresden and Vienna), but only these two copies had come to light until the present writer happened upon a third one about a dozen years ago and purchased it for the Columbia University Library. This last-mentioned codex turned out to be in the handwriting of Johann Scheybl, a Tübingen professor who lived in the first three quarters of the sixteenth century. It is this manuscript which Professor Karpinski has translated and annotated with rare pains and with a scholarship which is very gratifying to American workers in this field.

The arrangement of the material is very convenient. The original work, transcribed with care, appears upon the left-hand page while a translation faces it from the opposite page, thus making it possible to compare the two with a minimum of trouble. At the foot of each page of text are notes relating to such matters as the variants in the three codices, while at the foot of each page of translation are notes explanatory of the text. We have nowhere a translation of a mathematical work in any language that is so conveniently arranged.

The task which Professor Karpinski set for himself was not an easy one. Scheybl wrote a hand which looks legible at first sight but which is difficult to read, as witness the facsimile inserted in this edition. Indeed it was no doubt due to the very fact that the handwriting was so illegible that we owe its acquisition by Columbia, since otherwise its value would have been recognized many years

ago. To be sure there was the Libri transcription of the translation attributed to Gherardo to help in reading the manuscript, and there was Rosen's translation from the Arabic (1831), but neither of these has the same wording, and neither could render much assistance in the difficult task.

The translation can best be described by the word sensible. It is fortunately not literal, for a literal translation of, say, "substantiæ radices cœquant" or "De substantia et drachmis res cœquantibus" would be unintelligible. Even such an expression as "et etiam si dicas" is better rendered by "another example" than by a verbatim translation. To be sure this freedom leads to inconsistencies, as when "Tria igitur huius substantiæ sunt radix; et substantia nouem" appears as "Therefore three (spelled) is the root of this x^2 (symbol), and x^2 is 9 (symbol)"; while the sentence "Substantia et 21 drachmæ 10 rebus æquiparantur," which follows, appears as "A square (word) and 21 units are equal to ten (spelled) unknowns" instead of, say, "$x^2 + 21 = 10x$." These variations in style are not at all confusing, however, because the student always has the original on the facing page.

The style of the problems of Al-Khowarizmi shows the Greek influence, that is, the questions are generally abstract; for example, "From a square I subtract three of its roots and multiply the remainder by itself; the sum total of this multiplication equals the square"; or, in the shorthand of modern algebra, $(x^2 - 3x)^2 = x^2$. There are, however, a few questions in the rule of three, apparently a product of the Orient, but all are so simple as to deserve no place in algebra.

Al-Khowarizmi can not be said to have made any discovery in algebra. He was essentially a compiler of problems which he solved by methods already known. He invented no symbolism as Diophantus apparently did, nor did he show the remarkable genius of this last great representative of the dying mathematics of a dying Greek civilization. He contributed nothing to the solution of the quadratic that the Alexandrian school had not known, and even the special cases of the cubic equation were as a sealed book to him. His problems lack the delicious imagery to be found in the Hindu schools of his time, and the same is true, oddly enough, of those of the great Persian algebraist and poet Omar Khayyam.

Whatever may be said, however, of the details of the work itself, it is evident that Al-Khowarizmi will always occupy a prominent place in the history of mathematics, and that Dr. Karpinski's publication will rank as the first noteworthy effort in our country in the editing of a renaissance manuscript on the subject of algebra. The thanks of all scholars are due to him for his careful work and to the University of Michigan for publishing the result in such a satisfactory style.

DAVID EUGENE SMITH

Fungoid Diseases. An English-American Book. London, Longmans, Green and Co. 118 pp. Price 65c.

The latest book on fungi to come to hand is a pleasing little volume by Thomas Milburn and E. A. Bessey, entitled "Fungoid Diseases of Farm and Garden Crops." The title betrays its English origin, for if written in America it would have been called "Fungous Diseases" or perhaps by a select few "Fun*gus* Diseases." The English have not the reputation of being so far advanced as Americans in the application of remedies for fungous diseases, yet when it comes to writing general semi-popular books on the nature of fungi they lead them by many volumes, as represented by those published by Berkeley, Smith, Cooke and Massee.

The volume under consideration, more than any of its English predecessors, puts stress on practical treatment. As partially indicated by the title, it does not discuss the diseases of fruits, but rather those of cereals, legumes, root crops and certain vegetables, with a short chapter on fungoid diseases of animals. This limits its usefulness for a wide class of readers, especially in this country. The descriptions are popular, followed in each case by a paragraph on preventive measures. The book was written "primarily for the use of farmers,

gardeners and agricultural students," and no doubt fills a need for a brief popular presentation. However, the diseases selected are on the whole a little more applicable to English than to American needs, though many of them are among our common troubles.

Milburn is secretary of agriculture and lecturer in agriculture, Lancashire County Council, England, and Bessey is professor of botany in our own Michigan Agricultural College. The latter's connection with the work has been largely confined to a prefatory note and a little of the subject-matter, especially in the introductory chapter dealing with the nature and classification of fungi and with fungicides. Bessey's connection with this book makes it the fifth on plant diseases that has been put forth by American authors in recent years, and we understand that a revision of one of these and a new one are now in preparation, showing the growing importance of vegetable pathology in this country. All of the books presented so far or under consideration are by men who have devoted more of their time to teaching than to the experimental side of plant pathology, especially as regards prevention of disease. The next author of a book on plant diseases should come from the latter class.

G. P. Clinton

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The second number of Volume 2 of the *Proceedings of the National Academy of Sciences* contains the following articles:

1. *Personal Equation and Steadiness of Judgment in the Estimation of the Number of Objects in Moderately Large Samples:* J. Arthur Harris, Station for Experimental Evolution, Cold Spring Harbor, N. Y.

While there is no certain differentiation among the experimenters in personal equation, they differ distinctly in steadiness of judgment. The latter is conspicuous in contrast with the former in that it is unmistakably influenced by previous experience.

2. *Polypeptide-Hydantoins:* Treat B. Johnson, Sheffield Scientific School, Yale University.

The formulas for a large number of polypeptide-hydantoins are set up. Some of these substances have already been synthesized and methods for synthesizing others are being developed.

3. *Recent Explorations in the Cactus Deserts of South America:* J. N. Rose, Division of Plants, U. S. National Museum, Washington.

Large collections of cacti in South America have been made, including many species which have never before been collected and some which, though collected, have been poorly described or wrongly classified.

4. *On the Albedo of the Planets and Their Satellites:* Henry Norris Russell.

A table is given of the values finally derived for the albedo of the various planets and satellites. The values are in agreement with the current views of the constitution of the bodies. The value for the earth is intermediate between those of cloudy and cloudless planets.

5. *Quantum Relations in Photo-Electric Phenomena:* R. A. Millikan, Ryerson Physical Laboratory, University of Chicago.

So far as experiment has thus far gone Einstein's equation seems to be an exact statement of the energies of emission of corpuscles under the influence of light waves. Thus the correctness of the quantum theory and the reality of Planck's h are corroborated.

6. *The Chemical Activity of the Ions of Hydrochloric Acid Determined by Electromotive Force Measurements:* James H. Ellis, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology.

In this paper are presented accurate measurements of the electromotive force at 18, 25 and 35° of voltaic cells of the type H_2, HCl, $Hg_2Cl_2 + Hg$, with the acid-concentration varying from 0.03–4.5 normal. From the data are calculated the energy effects attending the reaction which takes place in such cells and those attending the transfer of hydrochloric acid in aqueous solution from one concentration to another. From these results are then calculated the chemical activities (or effective

concentrations) of the ions of the acid. These activities are shown to decrease with increasing concentration much more rapidly than do the ion-concentrations derived in the usual way from the electrical conductance ratio.

7. *Effects of Centrifugal Force on the Polarity of the Eggs of Crepidula:* EDWIN G. CONKLIN, Department of Biology, Princeton University.

It is difficult, but not absolutely impossible, to change the polarity of eggs and cleavage cells, and the persistence of polarity and the restoration of dislocated parts to normal condition is connected with a somewhat resistant framework of protoplasmic strands.

8. *The Emission Quanta of Characteristic X-Rays:* DAVID L. WEBSTER, Jefferson Physical Laboratory, Harvard University.

To excite any characteristic radiation it is necessary to use a potential above a critical value. The lines all increase in the same ratio for any given increase of potential. There is reason to believe that the characteristic rays are always a result of excitation of higher frequency oscillators.

9. *The Results of Investigations of the Ecology of the Floridian and Bahaman Shoal-Water Corals:* THOMAS WAYLAND VAUGHAN, U. S. Geological Survey, Washington, D. C.

The ability of corals to remove sediment from their surfaces, their mechanism for catching food, their carnivorous nature, their relation to light and temperature, and so on, have been studied.

10. *Cambrian Trilobites:* CHARLES D. WALCOTT, Smithsonian Institution, Washington, D. C.

Data have been assembled to aid in clearing up some of the problems of formations of the Appalachian region by a careful comparison of portions of their contained faunas with those of other localities.

11. *The Minute Structure of the Solar Atmosphere:* GEORGE E. HALE and FERDINAND ELLERMAN, Mt. Wilson Solar Observatory, Carnegie Institution of Washington.

The minute structure of the quiescent solar atmosphere resembles that of the photosphere. The results apparently support the hypothesis that the solar atmosphere consists of parallel columns of ascending and expanding gases, but such questions as the dimensions of the columns and the direction of motion and velocity are reserved for subsequent discussion.

12. *Monochromatic Photography of Jupiter and Saturn:* R. W. WOOD, Department of Physics, Johns Hopkins University.

The variation of the appearance of Saturn and Jupiter when photographed with light of different wave-lengths suggests a mist or dust in the planet's atmosphere which scatters the shorter wave-lengths.

EDWIN BIDWELL WILSON
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SPECIAL ARTICLES

PHOTOGRAPHS SHOWING THE RELATIVE DEFLECTION OF THE POSITIVE AND OF THE NEGATIVE IONS AS COMPARED WITH THAT OF THE ELECTRON

POSITIVELY and negatively charged ions, atomic in size (commonly called "retrograde rays"), *accompany* the stream of electrons issuing from the cathode in a highly exhausted discharge tube. Thomson[1] studied their properties by placing a photographic plate within the tube in such a position as to receive these rays after being deflected simultaneously by an electric and a magnetic field. When the fields are coincident (not crossed) the displacements on the photographic plate are in directions at right angles to each other. The photographic method is now in common use.

To the writer's knowledge no photographs, however, have been published in which all three of the component carriers—the positive ion, the negative ion and the electron—are shown simultaneously on the same plate. Since the mass of the electron is only 1/1700 that of the hydrogen atom, and since the square of the magnetic deflection varies inversely as the mass, it follows that the electron is driven off the plate by a magnetic field that would give the ion only an appreciably small deflection. By weakening the magnetic field the trace due to the electrons may be retained on the plate.

Two full-sized photographs, Figs. 1 and 2,

[1] J. J. Thomson, "Rays of Positive Electricity," pp. 75, 1913.

with key, Fig. 3, are submitted. Comparatively weak magnetic fields were employed.[2] The two coincident deflecting fields are sketched in Fig. 3, in which the direction of

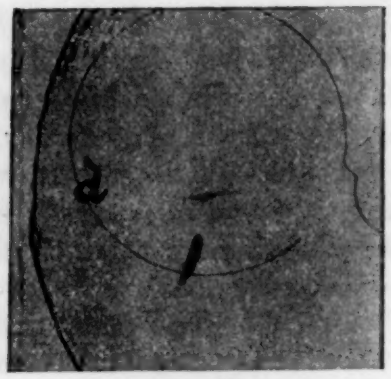

Fig. 1.

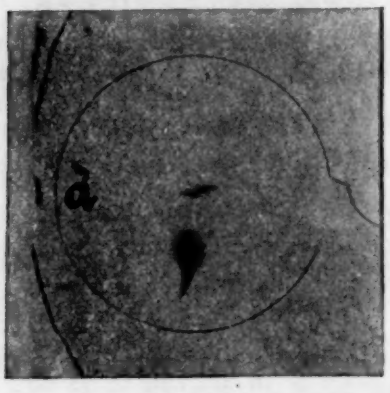

Fig. 2.

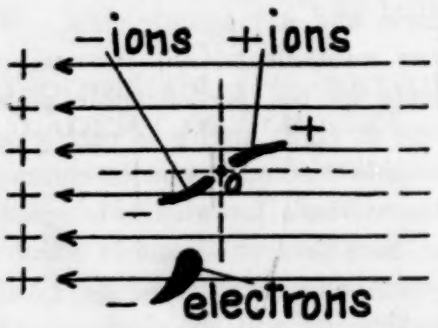

Fig. 3.

the electrostatic field is indicated by the minus and plus signs, while the arrow heads show the direction of the magnetic field. Again, magnetic deflections are up or down, while electrostatic deflections are to the right or left. The undeflected spot 0 is due to carriers that have lost their charge before entering the deflecting fields. In these photographs, Figs. 1 and 2, the traces due to the positive and negative ions unite at the central undeflected spot, the portion to the right of 0 being due to positive ions and that to the left negative ions, while the trace *e, due to electrons,* is distinctly separated from 0 and at some distance from it, and as we should expect, is in the same quadrant as the heavier negative ions. In Fig. 1 the time of exposure was 10 minutes, electrostatic field 2,070 volts per centimeter, magnetic field 1.7 amperes, and the vacuum .011 mm. mercury; while in Fig. 2 the corresponding values were 20 min., 2,070 volts, 2.25 amperes, and .005 mm. mercury. The effect of the stronger magnetic field is distinctly shown in Fig. 2 by the increased displacement from 0 of the trace due to the electrons.

Chas. T. Knipp

Laboratory of Physics,
University of Illinois

[2] For arrangement of apparatus see C. T. Knipp, *Phys. Rev.*, Vol. XXXIV., March, 1912.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

The sixty-eighth meeting of Section E, Geology and Geography, of the American Association for the Advancement of Science, was held in Orton Hall, Ohio State University, Columbus, Ohio, December 28 and 29, 1915. Vice-president C. S. Prosser presided. Professor R. D. Salisbury, University of Chicago, was elected vice-president of the association, and chairman of Section E for the next meeting, to be held in New York. Dr. C. P. Berkey, Columbia University, was elected a member of the council, Dr. J. W. Beede, University of Indiana, a member of the sectional committee, and Dr. E. R. Cumings, University of Indiana, a member of the general committee.

The titles and abstracts of papers presented before Section E are given below:

The Classification of the Niagaran Formations of Western Ohio: Charles S. Prosser.

A series of sections along Ludlow Creek, near Covington and near Lewisburg in western Ohio, which extend from the upper part of the Richmond formation to near the top of the Niagaran series are fully described. Also the Derbyshire Falls section, near Laurel, Indiana, is described and it is shown that this important and well-known limestone extends into Ohio and is worked at several

quarries, as for example, the Lewisburg Stone Company, northwest of Lewisburg and the Jackson quarry, south of Covington. Dr. Foerste's name of Brassfield formation is adopted for what was formerly called the Clinton limestone in Ohio, and as the result of recent work by Schuchert and others it is to be correlated with the Medina rather than the Clinton formation of New York. If this correlation be accepted, then the Brassfield formation is to be transferred from the Niagaran to the Oswegan series of the Silurian system.

The following classification is proposed for these formations in western Ohio:

Cayugan series.—Monroe Formation.

Silurian System

- Niagaran Series.
  - Cedarville dolomite. Lower 15 feet shown.
  - Springfield dolomite, 13 feet.
  - A mottled-colored zone which has been called West Union, 4 to 7 feet.
  - Laurel Limestone, 7 to 10 feet.
  - Osgood Beds
    - Shale zone, 2 to 3 feet.
    - Dayton limestone, 8 to 11 feet.
- Oswegan Series.
  - Brassfield limestone, 26½ to 28½ feet.

Cincinnatian Series. Belfast bed at top of Richmond formation.

The Stratigraphic Position of the Hillsboro Sandstone: CHARLES S. PROSSER.

In Highland County in southern Ohio a sandstone composed of grains of quartz sand occurs which was named the Hillsboro sandstone by Dr. Orton and regarded as forming the uppermost division of the Niagaran series. In the summer of 1915 outcrops were found on the southern slope of Quaker Hill, about five miles north of Hillsboro, which give a better section than any that has previously been described. The hill is capped by the Ohio shale; below this is 13 feet of drab-colored compact limestone with the lithologic characters of the Monroe formation and containing fossils that occur only in this formation. Then 2½ feet of quartz sandstone is exposed which is the Hillsboro, and stratigraphically below this sandstone is limestone lithologically like the Monroe in which fossils were found that are known only in the Greenfield dolomite, which is the basal member of the Monroe formation. Twelve and one fourth feet below the exposed base of the upper sandstone is a 2-foot layer of similar sandstone which probably has been included in the Hillsboro sandstone and beneath this is nearly 3 feet of limestone still with the lithologic appearance of the Monroe, but fossils were not found in it. Under this zone is porous rock with the lithologic character of the Cedarville dolomite in which specimens of *Trimerella* were found, a genus of brachiopod shells that is known only in the Cedarville and Guelph formations of North America and the upper part of the Silurian in the Baltic region of Europe. The occurrence of fossils known only in the Greenfield member of the Monroe formation in rock lithologically like the Monroe below the higher layer of sandstone and the continuance of the rock with the lithologic appearance of the Monroe below the lower sandstone is believed to prove that the Hillsboro sandstone belongs in the Monroe formation like the somewhat similar lithologic Sylvania sandstone of northwestern Ohio and southeastern Michigan.

The Berea Formation of Ohio and Pennsylvania: WALTER A. VERWIEBE.

The Berea has been studied in Ohio notably by Dr. Prosser, in Crawford county, Pa., by I. C. White, and along the Allegheny river by Charles Butts. In 1915 the author made an attempt to correlate the work of these three investigators. As a result the following conclusions were reached: (1) The Berea is represented in Pennsylvania by the Corry and Cussewago formations of White. (2) The Corry sandstone increases in thickness when followed eastward from the state line, attaining a thickness of about 50 feet along the Allegheny River. (3) The Corry sandstone becomes gradually coarser toward the east. (4) A limestone layer is practically always to be found under the Corry. (5) The Cussewago sandstone thins out and disappears from the section about longitude 80° 5′ W. (6) The Corry sandstone is represented along the Allegheny River by the sandstone indicated on Mr. Butts's general section as lying about 160 feet above the sandstone labeled "Berea (Corry)." (7) The Berea is absent along the Allegheny River north of Tidioute. The sandstone regarded as the Berea north of this point is probably the Venango First Oil Sand.

The Origin of the Newark Series in the Philadelphia District: HELEN MORNINGSTAR.

In the cut made by the Philadelphia and Western Electric Railway at the De Kalb Street Station, Bridgeport, Pennsylvania, the lowest member of the Newark Series in the Philadelphia District, the Stockton, is well exposed and consists of alternating beds of red and gray sandstone and conglomerate with pebbles varying from a fraction

of an inch to four or five inches in diameter. The constituents of the rock are coarse quartz sand grains, quartz pebbles, mica and a large amount of decomposed feldspar. Crossbedding is very prominent, and the conglomerate lies in lens-shaped masses which are tilted in almost any direction. A black carbonaceous layer of a few inches in thickness is also found in the outcrop. The character of the rock at this locality seems to prove conclusively that it is of terrestrial origin and accumulated as fluviatile deposits on piedmont slopes under semi-arid climatic conditions. The origin can best be explained by comparison with the large alluvial deposits forming at the present time in the Valley of California between the Sierra Nevada Mountains and the Coast Range, where a semi-arid climate prevails, where there is a constant large supply of débris for the streams to transport, and where the change of gradient is sufficient for the deposition of the load. In such cases there is an assortment of sediments, the coarser materials being deposited in the piedmont regions while the finer materials are carried farther out. As the deposit seen in the Railway Cut at the locality described is situated on the extreme southeastern border of the Newark area in the vicinity of Philadelphia, it is best explained as the work of a stream which flowed into the region from the southeast, the coarse conglomerates representing a phase of alluvial deposition such as is found near the point where the stream emerges from a bordering highland. The crossbedding, such as found here, is a marked characteristic of alluvial deposits made by streams of an arid or semi-arid climate during the period of torrential rainfall. The red color of the rocks and the large amount of decomposed feldspar, also indicate semi-arid climatic conditions. The presence of the carbonaceous layer, the total absence of marine fauna, the ripple marks, sun cracks, animal tracks and the remains of land animals, which have been found in the Newark rocks of the Philadelphia District—all point toward a terrestrial or continental origin.

The Ordovician-Silurian Boundary in Ohio: W. H. Shideler.

Comparing the proposed new division plane at the base of the Richmond with the commonly accepted division at the top of the Richmond, 14 per cent. of the 395 Maysville species lived on into the Richmond, while not one of the 494 Richmond species lived on into the Medina or Clinton. Of the Richmond genera, 42 per cent. are unknown in the Maysville, compared with the 67 per cent. of the Medina and Clinton genera unknown in the Richmond. Three families end with the Maysville, fourteen with the Richmond. Three families first appear with the Richmond, while thirty-five families, two suborders, three orders and one subclass, are introduced in the Medina and Clinton. In Ohio the Belfast beds carry a fauna of Brassfield (Ohio "Clinton") species, so the top of the Richmond is at the top of the Elkhorn beds, and this position is taken as the Ordovician-Silurian boundary.

A Geological Section of the Lime Creek Beds of Iowa: A. O. Thomas.

Brecciation Effects in the Saint Louis Limestone: Francis M. Van Tuyl.

The Saint Louis limestone is locally much brecciated and disturbed in southeastern Iowa. Two main types of breccia may be recognized: First, an original breccia which occurs both as reefs and as stratified beds in the formation, and second, a subsequent breccia produced by mashing on a large scale in late Mississippian time. Small folds and overthrust faults are associated with the breccia of the last type.

An Organic Oolite from the Ordovician: Francis M. Van Tuyl.

The siliceous oolite which constitutes the transition bed between the St. Croix sandstone and Prairie du Chien dolomite in the Upper Mississippi valley possesses in addition to the ordinary concentric and radial structure minute sinuous tubules similar to those which characterize the calcareous alga, *Girvonella.*

The Stratigraphy of Flint Ridge, Ohio: Clara G. Mark.

Flint Ridge is located about forty miles east of Columbus and a few miles west of Zanesville, Ohio. It consists of a ridge extending in a general east and west direction and conspicuously higher than the surrounding country. All along its summit may be seen blocks of flint, many of them small, but some large enough to weigh several tons. These blocks of flint appear to be the broken-down fragments of a once continuous ledge. There has been a great diversity of opinion concerning the stratigraphic position of this flint and it has been tentatively assigned to various horizons, from that of the Lower Mercer limestone, to that of the Middle Kittanning, or No. VI., coal. In the spring of 1915 Mr. John Turkopp, a graduate student of Ohio State University, in making a geologic map

of Flint Ridge, found a gully in Poverty Run near the eastern end of the ridge, which shows the most complete section of the rocks below the flint that has yet been found. This paper gives a detailed account of this section, another one at the western end of the ridge, and for the purpose of correlation, one of Putnam Hill at Zanesville. Two limestones and two flints occur in the Poverty Run section. The upper limestone, which directly underlies the higher flint, resembles the Upper Putnam Hill limestone at Zanesville; the second limestone 27 feet below the base of the upper one resembles the Putnam Hill limestone, and a black flint 22½ feet below the base of the lower limestone resembles the Upper Mercer limestone at the foot of Putnam Hill, Zanesville.

Correlation of the Conemaugh with the Kansas-Pennsylvanian: J. W. BEEDE.

The Cleveland Gas Field: J. A. BOWNOCKER.

A year or two after gas was discovered at Findlay in 1884 a deep well was sunk at Cleveland and a little gas secured but it was not of commercial proportions. Other tests were made from time to time but without success until February, 1912, when two good wells were secured in the "Clinton" sand at a depth of about 2,700 feet. A year later 150 strings of tools were at work and wells were sunk in large numbers on town lots and in this way much money wasted. The producing territory lay along the western edge of Cleveland and in the adjacent town of Lakewood. Later work has carried it some miles west of that place and southwest toward Berea. The largest well yet drilled in this field had an initial flow at the rate of 14,000,000 cubic feet per day and the closed or rock pressure of the field was about 1,050 pounds per square inch. The limits of this field have not been determined. In February, 1913, a large volume of gas was struck in the valley of the Cuyahoga, well within the city limits of Cleveland. The initial flow of the first well started at 10,000,000 cubic feet per day and other wells were sunk as rapidly as the drill could be forced down with the result that the limits of this field were soon determined while the proximity of wells made them short lived. The producing sand was not the "Clinton" but a higher one imbedded in the Silurian limestones. Rocks in the vicinity of Cleveland rise to the northwest and anticlines have not been located, though small ones may be present. Apparently the gas has worked its way from the southeast to the higher places, that is, to vicinity of Cleveland.

Oolitic Building Stone of the Bowling Green Field, Kentucky: M. H. CRUMP.

This remarkable building stone so beautifully seen in such handsome edifices as St. Thomas (Episcopal) Church, 53d street and Fifth avenue, New York; Hall of Records, Brooklyn; Manufacturer's Club, Philadelphia; the Everett mansion, Sheridan Circle, Washington, D. C.; and in many federal buildings throughout the United States, is found in the upper beds of the St. Louis limestone, covering an extent of some 200 miles in the county of Warren, state of Kentucky. It runs from ten to twenty-two feet thick, without a seam, and averages fifteen feet of commercial stone, which means 653,400 cubic feet per acre, or a total of more than eight and one third billion cubic feet immediately in sight, and ready to be put on the cars for less than ten cents per foot, where it is worth fifty cents. Professor Shaler speaks of it as "Occurring in layers of excellent form for use, readily worked, and with a rare quality of endurance—rather soft, so that it can be easily carved, but on exposure acquires much greater hardness. Add to this a rare beauty of color—a cream tint—and an endurance of color, and you have all the desirable qualities of a building stone well represented." Its ultimate crushing strength per square inch is 6,157 lbs., weight 167 lbs., carbonate of lime 97.69 per cent., water absorbed 6.2 per cent., U. S. Government Test.

Reames Cave: THOMAS M. HILLS.

Reames Cave, which is located in central Ohio, is the largest cave in the state. It occurs in zones B and C of an outlier of Columbus limestone, which was shaped by the ice and partly covered by drift. The total length of the galleries is nearly a mile. They have a maximum width of fifty feet. Deposition of iron oxide and calcium carbonate are being made contemporaneously.

Comparative Notes on the Loess of the Danube and the Rhine: B. SHIMEK.

The Loesses of the Mississippi Valley: B. SHIMEK.

A discussion of the several types of loess, with notes on their geographic distribution and stratigraphic relation. The several loesses represent distinct periods of time. Their peculiarities are, in part, accounted for by differences in source of materials.

Group Relationship among Physiographic Features as an Aid in Field Interpretation: GEORGE D. HUBBARD.

This paper shows what is meant by group relationship in physiography; how the notion of group relations among features is of value in description, explanation and classification of the features, and how a recognition of such relationships among features may be of assistance in the interpretation of field problems.

The Pleistocene of Capitol Hill, Des Moines, Ia.: James H. Lees.

Some Evidence Regarding the Duration of the Yarmouth Inter-glacial Epoch: George F. Kay.

That the time interval between the retreat of the Kansan ice and the advance of the Illinoian ice into Iowa was of long duration is suggested strongly by recent studies in the area of Kansan drift in southern Iowa. This view regarding the Yarmouth Inter-glacial epoch is supported by evidence as follows: (1) On the Kansan drift where erosion has been slight there is a thoroughly leached, non-laminated, tenacious clay called gumbo, twenty feet or more in thickness, which is thought to have been formed chiefly by chemical weathering of the upper part of the Kansan drift. (2) Diastrophic movements subsequent to the formation of the gumbo, the country having been elevated one hundred and fifty to two hundred feet. (3) A mature topography which was developed by erosion after the diastrophism and, apparently, in the main, before the close of the Yarmouth epoch.

Valley Trenching and Graduation Plains in Southern Indiana and Associated Regions: Clyde A. Malott.

This paper attempts to establish a partial peneplain in the central Mississippi valley post-Lafayette in age. East White River basin of southern Indiana furnishes the type region, where at least three former base levels are in evidence. Through the middle part of this river basin in the region of limestones and resistant sandstones, a gradation plain is evident at about eighty feet above the present streams. This gradation plain traced to the areas of soft rocks corresponds with the general upland level of the soft Devonian shale and lower member of the Knobstone group of middle eastern Indiana and of the soft sandstones and shales of the productive Coal Measures of the southwestern part of the state. At a hundred to a hundred fifty feet above this gradation plain is a peneplain of rather general prevalence in the harder rocks of the state. It is represented in the soft rock areas by monadnocks and rugged uplands only. This peneplain is called the Mitchell plain in southern Indiana. Again in the harder rocks is found a yet higher base-level, a hundred to two hundred feet above the Mitchell plain. This level is represented by monadnocks and flat-topped divides. It forms the highest land in the southern part of the state. The age of the gradation plain, marked by the lower uplands of the state, is found by tracing it across southern Illinois to the Ozark region, where it is seen to be developed at a lower level than the peneplain which has upon it the gravels of supposed Lafayette age. Moreover the Mitchell peneplain can be traced interruptedly by monadnocks to the Shawneetown Hills and Karbers Ridge which represent the level of the Lafayette gravel peneplain of the Ozark Plateau. The highest level of southern Indiana is correlated with the Lexington plain of Kentucky and the Highland Rim of Tennessee, and with less assurance with the base-level some two hundred feet above the Lafayette level of the Ozark region. In literature it is placed in early Tertiary age. Evidence of a post-Lafayette gradation plain or local peneplain is found in several places in the Mississippi valley. In the Nashville Basin of Tennessee the flat peneplain along Stones River is some eighty to a hundred feet below the frequent Lafayette gravel capped hills, and the stream is also trenched below the peneplain. Again, in the Driftless area of Wisconsin, broad "basin valleys" are found at one hundred feet lower than the Lancaster peneplain determined by Grant, Bain and others to be Lafayette in age. These "basin valleys" no doubt represent a gradation plain, and are in a position similar to the gradation plain of Indiana. Still another instance may be found in the Parker strata of the upper Ohio. Thus, taking all the evidence into consideration, it seems that there is a rather widespread base-level plain of post-Lafayette age over the Mississippi valley. In southern Indiana it was developed long before the advent of the Illinoian glacial ice.

The Extremes of Mountain Glacial Erosion: Wm. H. Hobbs.

In a series of articles printed in the year 1910, the writer pointed out that the mountain districts which in the past have been occupied by mountain glaciers, represent each a particular stage in a cycle of erosion, or especially of a receding hemicycle. The Bighorn range of Wyoming was cited as the best example of the early stage where glacial sculpture has modified but a small portion of the inherited upland surface. This topographic

type was designated a *grooved upland*, since the glacial troughs heading in semicircular cirques invade the upland. The opposite extreme, in which the entire inherited surface has been destroyed through glacial sculpture, was termed a *fretted upland* for obvious reasons, and the Alps cited as the type example. The characteristic of this type of upland—the Sierra—consists in main lines of palisades, or comb-ridges, from which lateral spurs of palisades diverge at frequent intervals. The general dominance of this type of topography in most regions where mountain glaciers have been, would seem to imply that mountain glacial sculpture proceeds with great rapidity through the enlargement and extension of the cirque; and that, further, this process is slowed down so soon as the pre-glacial upland has been removed. Otherwise we should expect that cols, or passes carved by cirque extension, would be much lower than they are.

A more extreme case of glacial sculpture seems to be illustrated by the northern Rocky Mountains, particularly within the Glacier National Park. Here in place of the comb-ridges, so characteristic of the fretted upland, we find an abundance of monument-like peaks, not the true horns merely within the fretted upland, but lower eminences which seem to have resulted from progressive lowering of the cols and the consequent coming into prominence of the broader parts of the comb ridges at either side of the entrance to the cirque from the U valley. This type of upland, an extreme product of mountain glacial erosion, we may designate a *monumented upland*. That the Bighorn range of Wyoming and the Glacier National Park thus present the extremes of mountain glacial erosion, was confirmed by studies which were carried out upon the ground in both districts during the summer of 1915.

The Earthquake in the Imperial Valley on June 22, 1915: W. H. HOBBS.

Outliers of the Maxville Limestone in Ohio, North of the Licking River: G. F. LAMB.

A Giant Pot-hole near Scranton, Pennsylvania: H. N. EATON.

The pot-hole in question is located about seven miles northeast of Scranton, Pa., in the ravine of a small stream on the southern side of Bald Mountain, 340 feet above the Lackawanna River. It is known to local naturalists and mining men on account of its great size, having a width at the top of 34 feet and a depth from the top to the débris at the bottom of 29 feet. The original depth was probably much greater. The bed rock is a gently dipping sandstone of a lower horizon of the Coal Measures. The origin of the hole by rotary abrasion is evident from its contour as shown in the photographs. Fluted and scoured rock surfaces in the immediate vicinity afford ample evidence of violent stream work, and although the glacial history of the region is not fully known it is probable that the pot-hole was formed by a stream issuing from the melting ice.

A New Occurrence of Crystallized Willemite: R. W. CLARK.

The willemite occurs in the Star District, Beaver County, Utah, in drusy masses of small crystals, which are sometimes colorless and sometimes red due to dilute coloring matter. It is associated with hemimorphite, calcite, mimetite, quartz, cerussite and limonite. The crystals show the following forms: c(0001), e(01$\bar{1}$2), a(11$\bar{2}$0), m(10$\bar{1}$0). The indices of refraction determined under the microscope by the immersion method are $\epsilon = 1.716$, $\omega = 1.690$.

The Girdled Mountain: A Direct Consequence of General Desert Erosion: CHARLES KEYES.

For the development of those rock-floored piedmonts which so often are characteristic of many arid regions there is an explanation much simpler than that usually given—one that is more in accordance with recent advancements in our knowledge of desert erosion. It does away with all of the assumptions necessarily arising out of the adoption of the old hypothesis which postulates prodigious valley-fill, and an uncovering by mountain freshets of an ancient bed-rock surface of the shallow margins of the intermont spaces. This old hypothesis had its foundation in the impression that the intermont plains are aggraded tracts instead of surfaces now undergoing rapid degradation, and that the agency is stream-corrasion much the same as in humid climates except perhaps somewhat less vigorous. The phenomenon is now believed to be one of the minor expressions of eolic erosion on that part of the orographic block which suffers maximum abrasion through natural sand-blast action. Many lofty desert mountains are thus deeply girdled just above the level at which the general plains surface meets them.

The Origin of the Coarse Breccia in the St. Louis Limestone: WILLIAM C. MORSE.

At least two kinds of breccia are present in the St. Louis limestone, one fine and the other coarse. The fine breccia is, in many cases, confined to a layer, or to two or three layers, at one or different

horizons, and undoubtedly owes its origin to forces operative at the time of deposition. The coarse breccia, on the other hand, is developed without regard to the limits of the layer and has a patchy, horizontal distribution. In one of the quarries in St. Louis County, Missouri, layers superjacent to a mass of coarsely brecciated limestone are bent down in such a way as to reveal the former presence of a limestone cavern. This structure in connection with other features led to the conclusion that the breccia is due to the collapse of the partially dissolved layers and of the cavern roof, and that the coarse breccia in western Illinois may have originated in a like manner.

Combination of Structures in the Colmar Oil Field in Western Illinois: William C. Morse.

In the Colmar Oil Field in western Illinois the Hoing sand is productive at 80 to 100 feet above sea level in the Lamoine terrace and at 165 feet in the adjacent Colmar dome. Salt water backs up the oil to the very edge of the terrace and, in fact, fills the lower part of the sand in the terrace itself. It likewise backs up the oil to the very crest of the dome. In some of the non-productive walls the sand is not present. From these facts it is evident that the sand in the terrace and in the dome constitutes two entirely separate patches; and recent development proves that the distribution of the oil and the salt water is dependent upon the structure of each individual patch of sand. In other words, the distribution of the oil and the salt water is not the result of the larger structure alone, but particularly that part of the larger structure within the limits of each sand patch. For example, the distribution of the oil in this area of elevated rocks is confined to the highest part of one patch of sand (terrace) and to the highest part of the other patch (dome).

Some Structural Geology of the Piedmont: John E. Smith.

The rocks under discussion are located in the "Slate and Schist Belt" in the eastern part of the Piedmont in North Carolina. A deep layer of mantle rock permits but few outcrops where unweathered material may be obtained for study. The sedimentary rocks consist of conglomerates, "slates," and breccias, each of which in places has been silicified. The gneisses and schists are derived from igneous and sedimentary rocks. These "Ancient Crystallines" are intensely folded, have steep dip with axes extending northeast and southwest in Orange County, are much reduced by erosion, and in many places have been cut by igneous intrusions and extrusions. The igneous rocks consist of granites, syenites and diorites, occurring as stocks some of which show zonation, and felsites, chiefly rhyolites, many of which have been sheared and altered. The rhyolites nearly all exhibit flow structure and appear prominently as rounded monadnocks and short ranges of low hills. The dikes are chiefly basic rocks. Contacts are rarely exposed. (Illustrated with structure sections.)

Geographic Causes in North Carolina: John E. Smith.

The natural divisions of North Carolina are the mountain region, the Piedmont plateau and the coastal plain. The climate varies with the elevation and with the distance from the sea, reaching its maximum range of temperature in the western part and the minimum along the coast. The rainfall is greatest in the southern part of the mountain region and near the sea. Some of the lake and swamp depressions of the coastal plain were formed by unequal deposition near the shore of a former sea and some by low barrier ridges built before the sea withdrew. The water in some of the lakes is partly of artesian origin. The railway systems are in topographic adjustment and there are two great power systems, one in the Piedmont and one on the coastal plain. The value of land is controlled by topography, fertility and accessibility, that of least value being the most remote in the mountains, the most rugged in the Piedmont, and the most swampy on the plain. Mills and factories are located chiefly in the Piedmont because those first built used water power. Hydro-electric is most popular now. Many of these industries came to the south to reduce expenses by operating in a mild winter climate near the raw materials used with cheap labor. The people of the state are distributed in accordance with the above-mentioned influences. (Illustrated with maps and charts.)

George F. Kay,
Secretary

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 547th regular, and 36th annual meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, December 18, 1915, called to order by President Bartsch, at 8 P.M., with 27 persons present.

On recommendation of the council the following persons were elected to active membership: H. R.

Rosen, U. S. National Museum; Miss Virginia Boone, U. S. National Museum; Ira N. Gabrielson, Biological Survey; James Silver.

Annual reports of officers and committees were submitted.

Election of officers for the year 1916 resulted as follows:

President, W. P. Hay.

Vice-presidents, J. N. Rose, A. D. Hopkins, Hugh M. Smith and Vernon Bailey.

Recording Secretary, M. W. Lyon, Jr.

Corresponding Secretary, W. L. McAtee.

Treasurer, W. W. Cooke.

Councillors, N. Hollister, J. W. Gidley, William Palmer, Alex. Wetmore, E. A. Mearns.

President Hay was elected a vice-president of the Washington Academy of Sciences.

The president announced the following committees:

Committee on Publications, N. Hollister, W. L. McAtee, W. W. Cooke.

Committee on Communications, Wm. Palmer, Alex. Wetmore, Lewis Radcliffe, J. W. Gidley, W. R. Maxon, H. S. Barber.

THE 548th meeting of the society was held in the Assembly Hall of the Cosmos Club on Saturday, January 15, 1916, called to order by President Hay at 8 P.M. with 40 persons present.

The president noted the recent death of F. M. Webster, long a member of the society.

Upon recommendation of the council the following were elected to active membership: H. F. Taylor, Bureau of Fisheries; Douglas C. Mabbott, Biological Survey; Wallace M. Yaters, Department of Agriculture.

Under the heading of Brief Notes and Exhibition of Specimens Mr. Wm. Palmer exhibited a specimen of seahorse which actually came from near Colonial Beach, Chesapeake Bay, but which had attained much newspaper notoriety as having been caught in the Tidal Basin, D. C. He also exhibited the collector's sketch of a pipefish which had been captured in the Tidal Basin.

The regular program was a communication by W. W. Cooke, "Notes on Labrador Birds." Mr. Cooke gave an interesting account of Mr. Clarence Birdseye's experiences and travels in Labrador during the past four years while engaged in farming silver gray foxes for their furs, describing the difficulties under which he labored and the disastrous effect of the European war on the fur market. The speaker then gave an historical survey of Labrador ornithology from the early days of Cartwright to Mr. Birdseye's latest observations, which includes the extension of range of several species of birds. Mr. Cooke's communication was illustrated with lantern slide views of maps of Labrador, maps of migrations of certain birds, and views of several birds which had lately been observed for the first time in eastern Labrador. Mr. Birdseye's observation on Labrador birds will appear in full in the April *Auk*.

Mr. Cooke's communication was discussed by Mr. Wm. Palmer and by Mr. Alex. Wetmore.

THE 549th regular meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, January 29, 1916, called to order at 8 P.M. by President Hay, with thirty persons present.

The recent and previously unnoticed deaths of members of the society, Dr. G. D. Elliot, A. M. Groves and C. E. Slocum were noted by the president. On recommendation of the council Dr. Walter K. Fisher, Stanford University, was elected to active membership.

Under the heading Brief Notes Dr. L. O. Howard told of some of the published anecdotes regarding the entomologist General Dejean who served under Napoleon I., and of his zeal as a collector even under the excitement of battle.

Under the same heading Dr. H. M. Smith called attention to the successful introduction of the tilefish into the markets, restaurants and homes of the United States.

Under the heading Exhibition of Specimens Dr. L. O. Howard exhibited a photographic lantern slide of Orsini's statue, *Proximus Tuus*, representing a malarial stricken Italian peasant. The statue was exhibited at the San Francisco fair and illustrations of it are used in a California antimosquito campaign. By way of contrast Dr. Howard showed a group of healthy children on the formerly malaria-infested Roman Campagna.

Under the same heading Mr. William Palmer exhibited several bones of extinct cetaceans recently collected by him at Chesapeake Beach, Maryland. He called attention to the work of Cope and of other paleontologists on this group and pointed out the relationships of the forms with some of the modern cetaceans.

The regular program comprised a paper by Ned Dearborn, "Fur Farming in Alaska." Dr. Dearborn pointed out the possibilities of fur farming in Alaska, stating that at present there are 75 localities in that territory where such farming is

carried on to a greater or less extent. The possible animals that may be bred for fur are the fox, mink, marten, otter and beaver, but so far it has only proved practicable with foxes and minks. Silver foxes are successfully bred in the interior and fed on salmon and rabbits to a large extent. Blue foxes are successfully raised along the coast, especially on certain of the islands. The paper was discussed by Dr. C. W. Stiles who called attention to the prevalence of certain forms of hookworms in the dogs and foxes of Europe and Alaska but seldom found in the dogs of the United States.

M. W. Lyon, Jr.,
Recording Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

The 110th regular meeting of the Botanical Society of Washington was held in the Assembly Hall of the Cosmos Club at 8 P.M., Tuesday, February 1, 1916. Fifty-three members and four guests were present. Messrs. Chas. H. Clark, Felix J. Schneiderhan, and Dr. T. Tanaka were elected to membership. The following papers were presented:

Egyptian Use of Date Tree Products Other than Fruit (with lantern): S. C. Mason.

To be published in full elsewhere.

Botanical and Economic Notes on the Dasheen (with lantern and exhibit): R. A. Young.

The dasheens represent one type of the taro, which is well known in the Orient and the Islands of the Pacific. All belong to the genus *Colocasia*. The variety under special consideration was the one known as the "Trinidad" from the island of Trinidad. It is believed to have come originally from China. Slides were shown illustrating the differences in floral and other characters between two very distinct types of *Colocasia*, which for the past sixty years have been included under the name *C. antiquorum* (L.) Schott. One of the types, which includes the dasheen, was recognized tentatively by Schott, in 1823, as a good species, under the name *C. esculenta* (L.) Schott. In 1856 he reduced it to a varietal rank. The other type, which is represented by the "qolqas" or "colocasia" of Egypt, is the species *C. antiquorum*. It is contended that the reduction of *C. esculenta* to varietal rank was an error and it is proposed to restore it to specific rank. The true *C. antiquorum* properly includes the common elephant-ear plant, generally referred to as *Caladium esculentum*, of Ventenat.

The dasheen is gaining in importance in the far south, and a northern market is developing. Many culinary experiments have been made and a number of delicious and attractive dishes have resulted. After the program, dasheens which had been parboiled and baked with electric stoves, were served.

The Pathological Inspection Work of the Federal Horticultural Board: Geo. R. Lyman.

The Plant Quarantine Law seeks to prevent the introduction into the United States of injurious plant diseases from abroad by requiring the inspection of imported plant material. The inspection of commercial importations presents few difficulties, inasmuch as the variety of host plants involved is not great and the importations are ordinarily from countries where the diseases are well known. But importations by the Department of Agriculture for experimental and introduction purposes present many problems, since they come from every quarter of the globe and are practically unlimited in variety of host plant. Both host and disease may be new and hence potentially dangerous. All such importations are received in a specially constructed inspection house in Washington, and the packages are opened in the presence of the inspectors, all wrappings being burned. The plant material is closely examined and suspicious specimens are referred to experts of the Department of Agriculture for study and determination. Extraordinary precautions are taken to prevent infection being carried on the hands or clothing of the inspectors.

After inspection the material may be (1) passed, if it is apparently clean; (2) burned, if dangerous diseases are found; (3) ordered fumigated or cleansed when the pests found can be eradicated by such treatment (facilities for treating material are present in the inspection room); or (4) ordered grown in quarantine. The quarantine greenhouse adjoining the inspection room is divided into small units where suspicuous plants may be isolated and grown under close observation until the proper disposition of them is determined.

Moreover, much of the material which passes inspection is ordered grown in the propagation gardens of the government, one of which is situated at Yarrow, Maryland. Here the plants are propagated and grown under observation and are given a last close inspection when finally ready for distribution.

W. E. Safford,
Corresponding Secretary